VOL. XVII. No. 10. OCTOBER 1932

MECCANO MAGAZINE

A FIGHTING SCOUT
(see page 734)

6D.

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MECCANO MAGAZINE

Editorial Office:
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Vol. XVII. No. 10
October, 1932

With the Editor

A Famous Ship's Bell

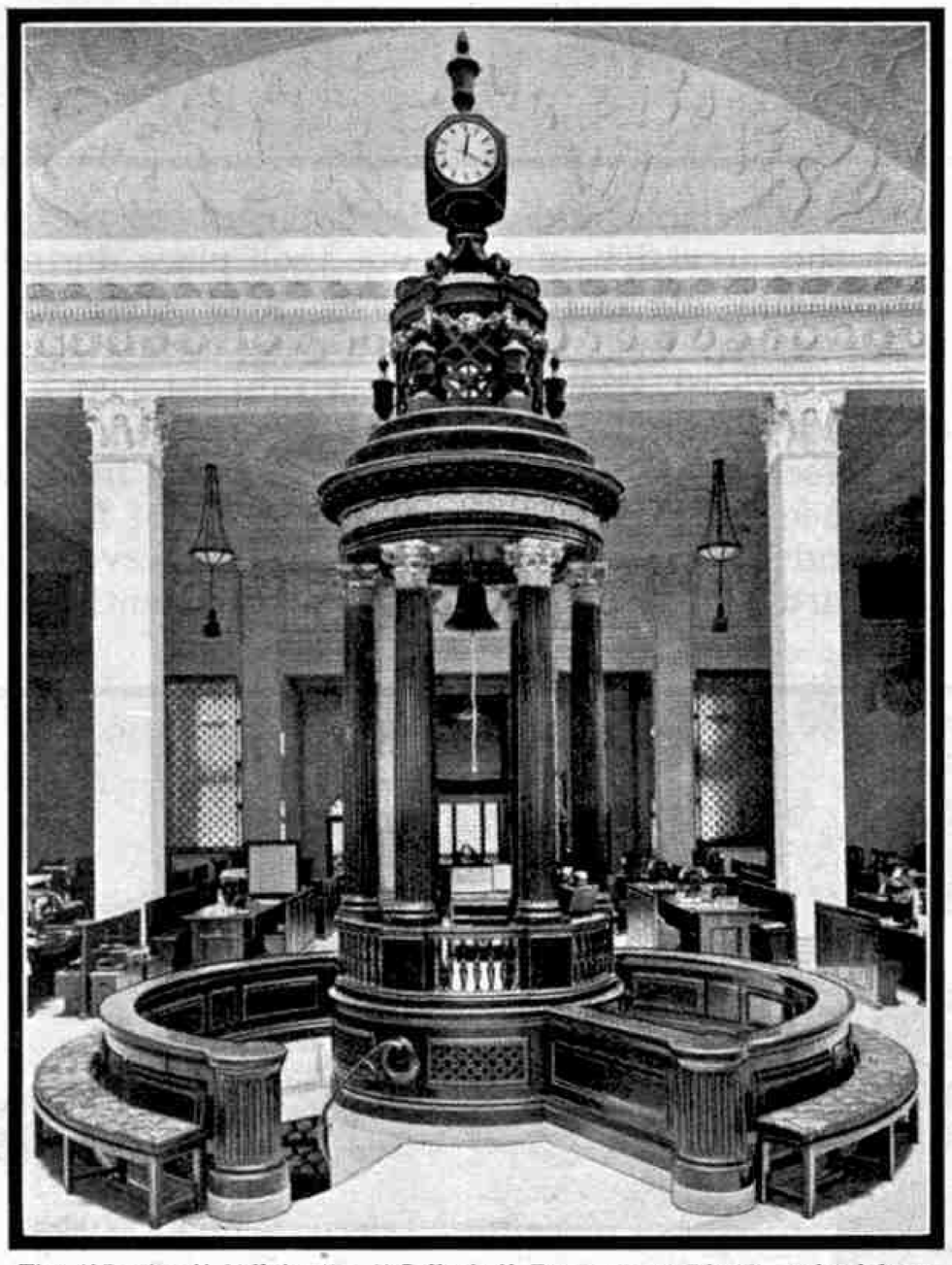
Many readers will have heard of the famous "Lutine" bell that is hung in the "Caller's" Rostrum at Lloyds, London, and is rung whenever an announcement of special importance is to be made, such as that of a lost or overdue ship. This bell was salved from H.M.S. "*Lutine*," which was wrecked 133 years ago this month off the coast of Holland.

H.M.S. "*Lutine*" was a frigate of 36 guns and was one of a French fleet of 18 ships surrendered to Hood at Toulon in 1793. In the autumn of 1799 it was necessary to send a large amount of specie across the North Sea, and the customary application was made to the Admiralty for a King's ship, as this method of conveyance was considered to offer the best protection against capture of the treasure by foreign foes. The application was granted, and early in October, 1799, the "*Lutine*" was ordered to Yarmouth to receive the specie and to proceed to the Elbe. It is not known definitely how much treasure was placed on board, but it is believed to have been at least £1,000,000, and to have included £127,000 intended to pay British troops then serving in Holland. The treasure was in the form of gold and silver bars and a great variety of coin, which included gold and silver English coins, dollars, guineas and gold and silver piastres.

The treasure was safely stowed on board and by the 5th October the ship was ready to depart. On the evening of that day the captain gave a great ball on board to which all the leading people in and about Yarmouth were invited, and the event was a great success. The last of the guests had hardly left the ship when the captain received orders from the Admiralty to put to sea immediately, and the "*Lutine*" sailed from Yarmouth in the early morning of 6th October, 1799. From that time little was ever heard of the ship. It is known that, aided by a high but favourable wind, she steered straight for Cuxhaven, at the mouth of the Elbe. With the prospect of the voyage being accomplished in quick time all on board were apparently in good spirits, and when some fishermen sighted the ship shortly before midnight she was brilliantly lighted up and sounds of merriment on board could be heard—an unusual state of affairs on a King's ship at that late hour.

The wind increased almost to gale force and carried the "*Lutine*" slightly out of her course, with the result that soon after midnight she struck on the outer bank of the island of Vlieland, one of a chain of islands near the coast of Holland. Another King's ship, the "*Arrow*," was with the "*Lutine*," but she was unable to render any assistance. The disaster was swift and complete, and when daylight came there was no sign of the ill-fated vessel. A Dutch lugger picked up two survivors, one of whom died immediately, and the other lived only long enough to tell the little that he knew of the circumstances of the tragedy.

Many attempts were subsequently made to recover the treasure, but the gradual breaking up of the ship and the covering of the wreckage by silting sand made the task increasingly difficult. In the year following the disaster, when the wreckage was still largely clear of sand, Dutchmen succeeded in fishing up treasure to the amount of about £55,000 and later and more systematic efforts yielded a further £50,000. Two of the "*Lutine's*" 36 guns also were salvaged. One of these was presented to Queen Victoria and is now at Windsor Castle; the other was given to the Corporation of London and is preserved in the Museum at the Guildhall.



The "Lutine" bell in the "Caller's" Rostrum at Lloyds, salved from H.M.S. "Lutine," which was wrecked in October, 1799.

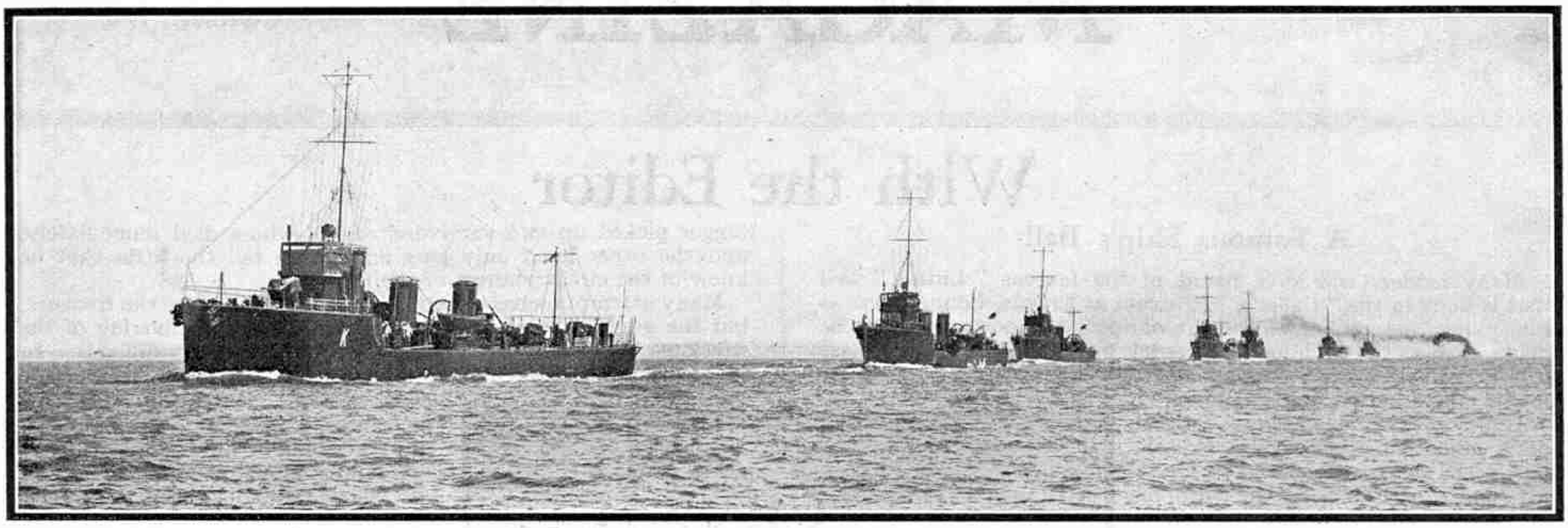
Engineers as Statesmen

One of the most outstanding of recent events was the meeting of the British Association at York last month. The Association celebrated its centenary last year in London under the presidency of General J. C. Smuts, P.C., C.H., F.R.S. By meeting this year in York it begins its second century in its birthplace, for its first meeting was held there in 1831, the year of its foundation by Sir David Brewster and his associates, of whom I wrote in the "*M.M.*" for September, 1931. Engineering figured very prominently at this year's meeting, for Sir Alfred Ewing, K.C.B., F.R.S., the President, is an engineer, and in his Presidential address showed how the engineer has scattered his gifts over the earth, and has harnessed the resources of nature for the benefit of mankind.

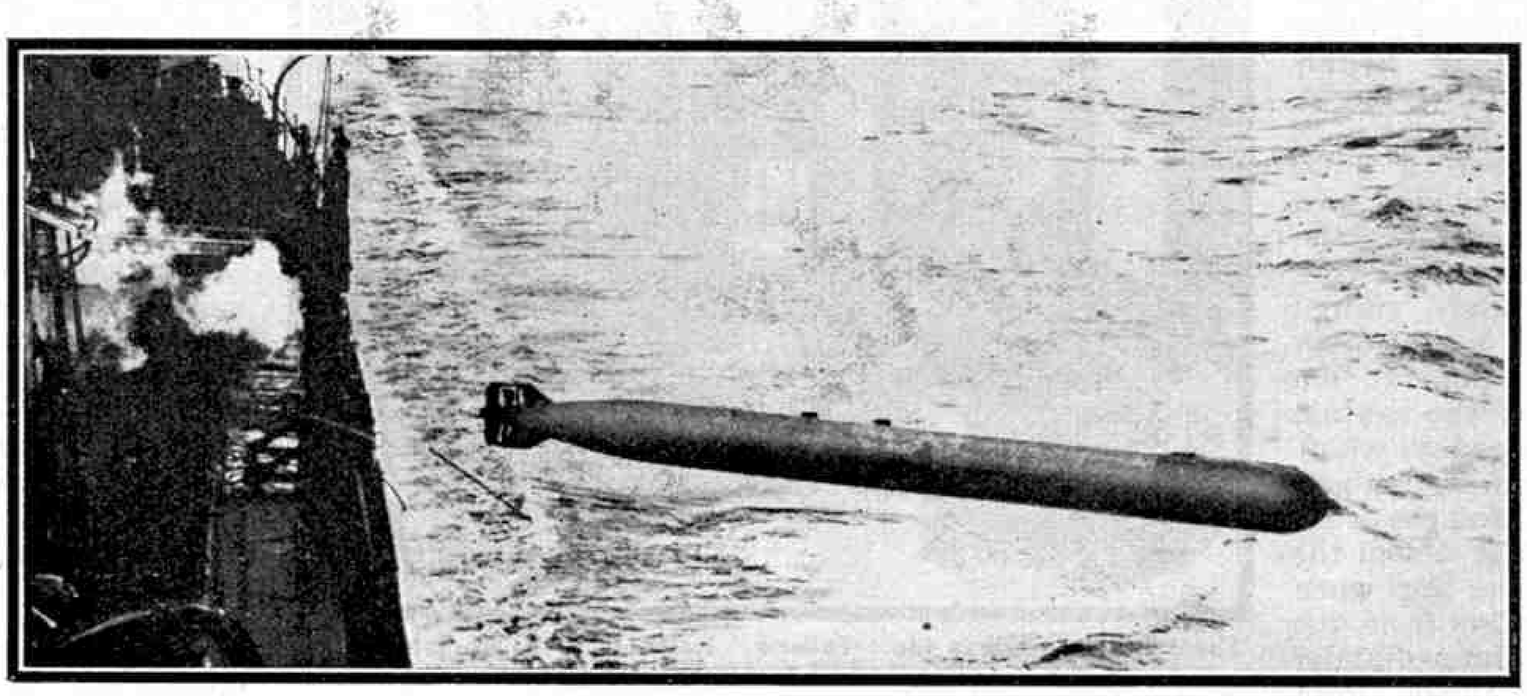
In the Engineering Section itself the suggestion was made that the House of Commons should be reformed on engineering lines. There is no doubt that mechanical aids would make the work of members easier. For instance, a considerable amount of time is wasted by retaining the old system of walking through lobbies in order to record votes. It would be easy to devise means for voting by merely pressing buttons, and a device for this purpose that has been in use in America for several years was described on page 547 of the "*M.M.*" for July, 1929. The author of the proposal would not be satisfied with reforms of this kind, however, for he declared that a committee of engineers would make a better job of State management than our present statesmen, because they had received the kind of training required to enable them to solve the varied and difficult problems with which they would be confronted. It is scarcely to be expected that there will be general agreement with this startling idea, but there is much to be said for the suggestion that members of the House of Commons should become more engineeringly-minded.

The Sleuth-Hounds of the Navy

Destroyers and Their Work



WHEN the torpedo developed into a reliable and accurate weapon there arose the necessity of providing suitable vessels for making use of it. The first British torpedo boat, the "*Vesuvius*" built in 1874, had a maximum speed of less than 10 knots, and was of little practical value. Rear-Admiral Sir S. M. Eardley-Wilmot refers to this vessel in his book "*An Admiral's Memories.*" "When I joined the '*Vernon*' in 1877," he writes, "she had as tender a peculiar small craft built at Pembroke Dockyard for torpedo service. The '*Vesuvius*' of 250 tons was 90 ft. long and a twin-screw steamer. In order that her approach to attack might not be observed the funnel was horizontal and led along the top of the deck to the stern, where the smoke was ejected close down to the water. To create a draught to the fires a fan was placed at the base of the funnel and so produced an induced draught, a distinction from forced draught. The funnel could be raised to a vertical position if desired."



The upper photograph shows a destroyer flotilla in the Solent in 1914. The first, third and fifth ships, the "Shark," "Sparrow Hawk" and "Spitfire" respectively, built by Swan, Hunter and Wigham Richardson Ltd., to whom we are indebted for our photograph, took part in the Battle of Jutland, the first two being lost. The lower illustration, by courtesy of the Whitehead Torpedo Co. Ltd., shows a torpedo immediately after being fired from its tube.

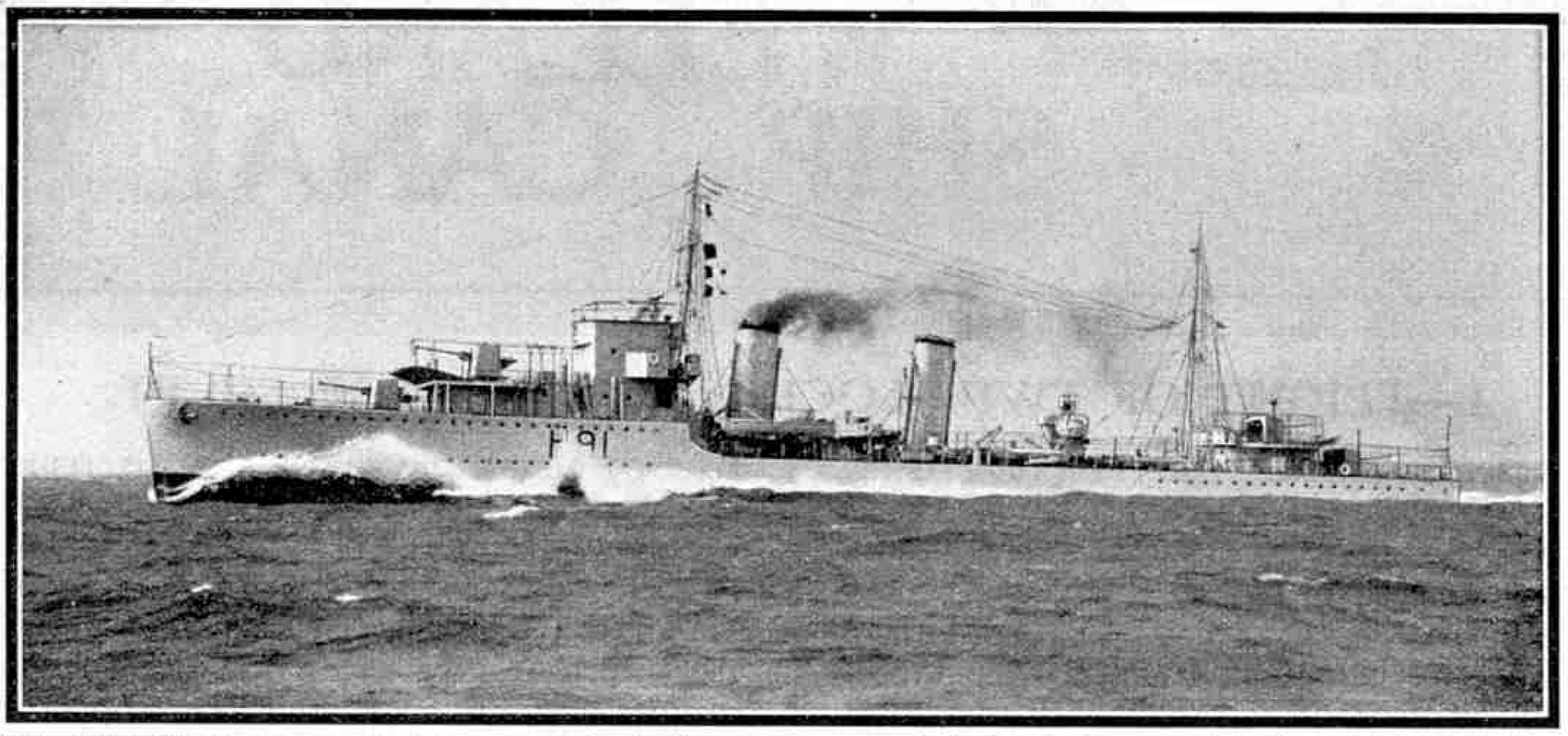
High speed was a prime necessity for vessels intended for torpedo service, and in 1877 a great step forward was made in the "*Lightning*" built by J. I. Thornycroft & Co. Ltd. This vessel had a speed of 19 knots, and was 87 ft. in length with a displacement of 28.5 tons. In the same year Yarrow & Co. Ltd. produced torpedo boats capable of a speed of 21 knots. A rapid development in the size and speed of vessels of this type took place during the next few years.

The next step was to evolve vessels capable of destroying enemy torpedo boats, and these were known as torpedo catchers or torpedo gunboats. Many vessels of this type were built during 1886 and the next few years, ranging from 500 to 1,000 tons displacement, with a speed of from 19 to 21 knots. They were not a success, however, being too slow for their purpose and not sufficiently seaworthy.

In 1906 appeared the first of a series of vessels known as coastal destroyers, afterwards re-classified as first-class torpedo boats, which had Parsons turbines and used oil fuel, and reached a speed of 27 knots. No further torpedo boats were built after 1909.

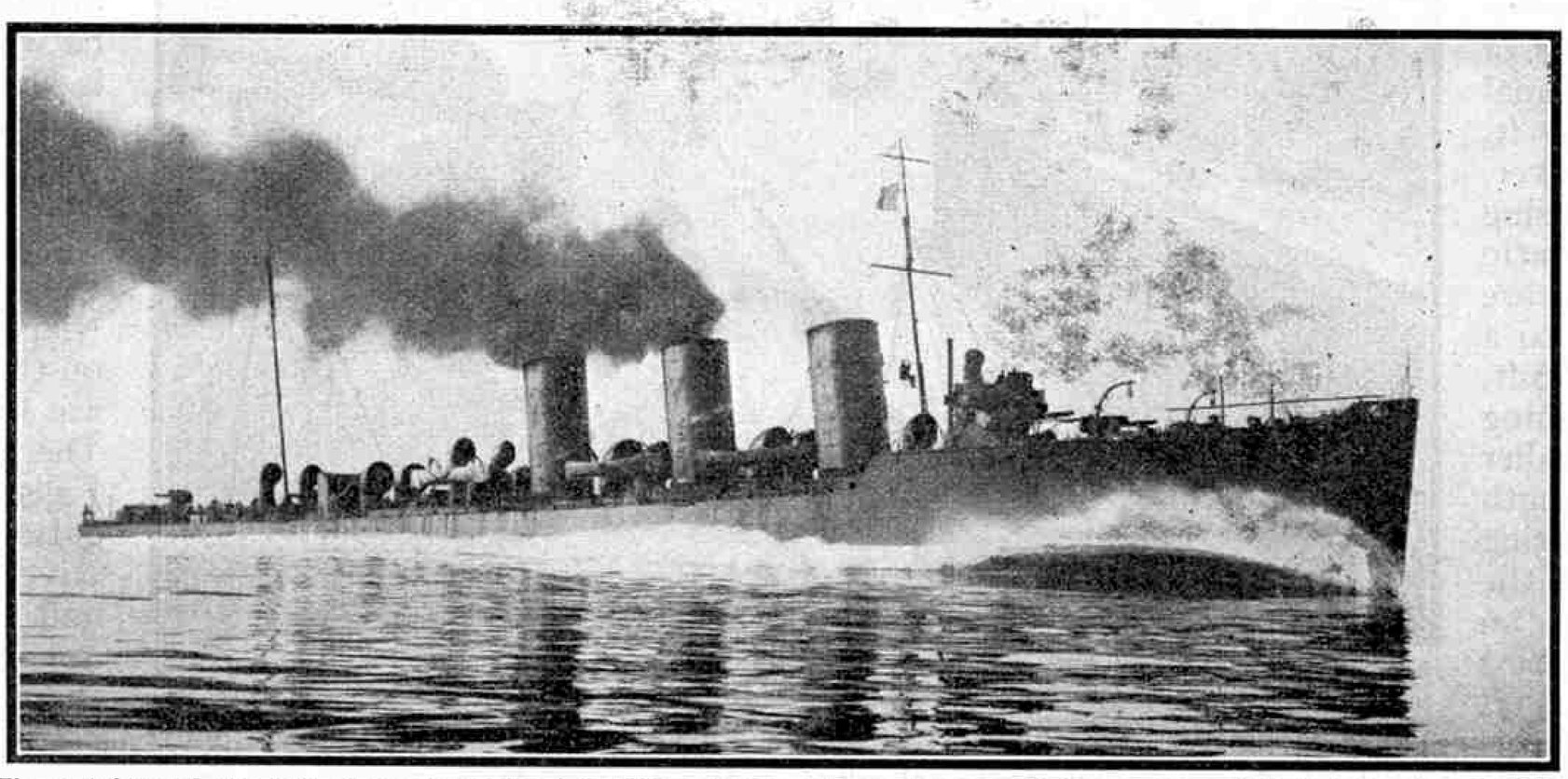
The need for really effective vessels for dealing with hostile torpedo boats led to the development of the torpedo boat destroyer. The first two vessels of this type, the "*Havock*" and the "*Hornet,*" were built by Yarrow & Co. Ltd. in 1893. They had a displacement of about 250 tons, and their speed of 27 knots was considerably greater than that of any torpedo boat then in existence. They carried one 12-pounder and three 6-pounder quick-firing guns, and had 18 in. torpedoes in place of the 14 in. torpedoes of the torpedo boats. In subsequent vessels the speed was considerably increased,

and the "*Viper*," the first British turbine-driven destroyer, built in 1899 by Hawthorn Leslie & Co. Ltd., attained a speed of 36.6 knots. Some of the succeeding destroyers showed signs of strength having been sacrificed to speed, and in 1903 were built the first of the "River" class, in which greater strength was attained with a reduction in speed to 25.5 knots. These vessels had a displacement of about 550 tons, and their sea-going qualities were improved by the fitting of a high forecastle. In 1910 was completed the experimental destroyer "*Swift*," of 2,170 tons displacement. This remarkable vessel was 345 ft. in length and 34 ft. in beam, and her engines of 30,000 h.p. gave her a speed of 36 knots. On one occasion, on trials, she reached a speed of nearly 39 knots.



The "Bulldog," a recent type of destroyer, propelled by twin-screws and single-reduction geared turbines. Photograph by courtesy of Swan, Hunter and Wigham Richardson Ltd.

Large numbers of destroyers were built during the Great War. The "R" class, 1915-17, and the "S" class, 1917-18, had a displacement of about 1,000 tons and a speed of about 26 knots. The vessel shown on our cover is the "*Stalwart*" of the "S" class built by Swan, Hunter & Wigham Richardson Ltd., and presented to the Royal Australian Navy in 1919. The fine photograph from which the cover was prepared was taken by Messrs. Frank & Sons of South Shields. The "V" and "W" classes built in 1916-18 were of about 1,300 tons and had a speed of 34 to 35 knots.



The experimental destroyer "Swift," completed in 1910. This vessel, of 2,170 tons displacement, was 345 ft. in length and 34 ft. in beam, and on trials reached a speed of nearly 39 knots. Photograph by courtesy of Cammell Laird & Co. Ltd., the builders.

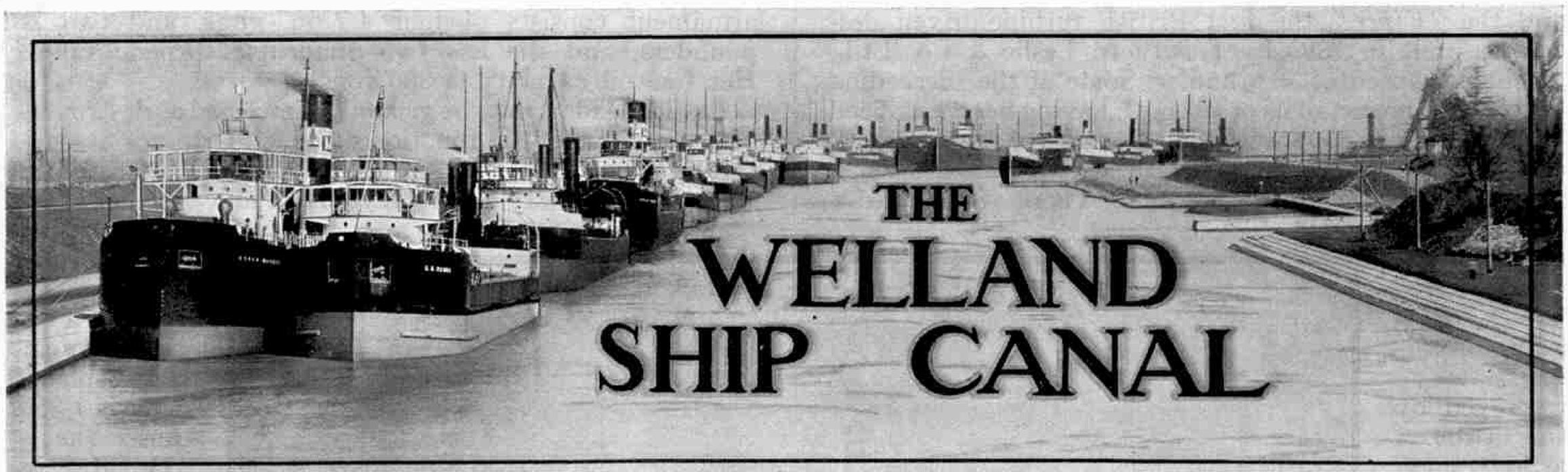
Many fine destroyers have been built since the War. Last year was completed the "*Acheron*," the first destroyer to be specially equipped with machinery to use high-pressure steam with the object of securing greater economy in the consumption of fuel. This vessel has a displacement of 1,330 tons, is 323 ft. in length overall, and 32.25 ft. in beam, and has a draught of 8.5 ft. Her boiler pressure is 500 lb. per sq. in., with a steam temperature of 750 deg. F., and her Parsons turbines develop 34,000 h.p., giving a speed of 35 knots. Her main armament consists of four 4.7 in. guns, and two 2-pounders, and she has two quadruple torpedo tubes. Her fuel oil capacity is 380 tons.

Flotilla leaders may be generally described as destroyers of a larger type, the function of which is to act as flagships to destroyer flotillas. The "*Keith*," completed in 1931, breaks away from previous practice in being no larger or more powerful than an ordinary destroyer. Her displacement is 1,350 tons; she is 324 ft. in extreme length, and 32.25 ft. in beam, and has a draught of 8.5 ft. Her speed is 35 knots, and her main armament consists of four 4.7 in. guns and two 2-pounders, with two quadruple torpedo tubes.

The early destroyers were commanded by a Lieutenant, with a Sub-Lieutenant or Gunner, and a Warrant Engineer. The modern destroyer is commanded by a Lieutenant-Commander, with two or three Lieutenants, an Engineer Lieutenant and Warrant Officers.

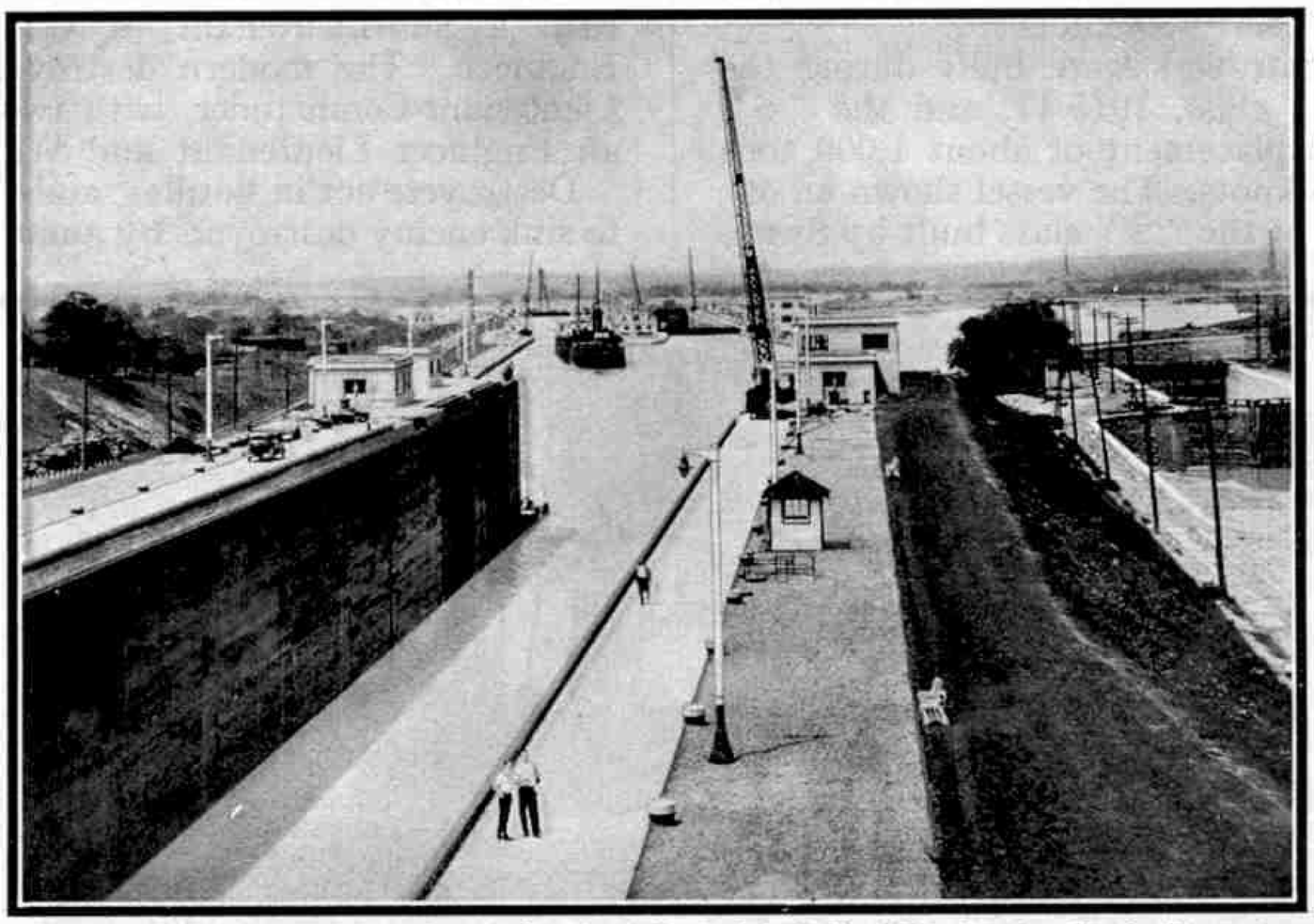
Destroyers act in flotillas, and their main functions are to sink enemy destroyers by gunfire and larger vessels by torpedoes, to protect the large ships of their own Navy from torpedo attack, and to set up smoke screens when required. During the Great War the British destroyers played an extremely important part in convoying merchant vessels and warding off attacks by enemy submarines.

In his book "*The Brotherhood of the Sea*," Mr. E. Keble Chatterton gives a fascinating description of British destroyers. "During the Great War," he writes, "these destroyers, both individually as private vessels and collectively as divisions or flotillas, performed the most trying and gallant service. But their splendid work has never yet received its full appreciation, for the reason that these great achievements have been swallowed up by the importance of major operations; strategy . . . has been regarded as more interesting than brilliant tactics, and the work of the battle fleet has (*Continued on page 770*)



I.—FLIGHT OF TWIN LOCKS WITH LIFT OF 140 FT.

ONE of the greatest engineering feats ever undertaken has now been completed in Canada. This is the construction of the Welland Ship Canal, by means of which vessels up to 800 ft. in length may cross the Niagara peninsula, which separates Lake Erie from Lake Ontario. From an engineering point of view this magnificent waterway ranks with the Suez and the Panama Canals. It is 25 miles in length, and thus is shorter than its older rivals, but it is remarkable for the wonderful locks that have been built in its course. The total rise provided by the locks of the Panama Canal is 85 ft., while the Suez Canal is practically at sea level throughout. Seven of the eight locks of the Welland Canal have lifts of 46 ft. 6 in. each, however, and vessels passing from Lake Ontario to Lake Erie are raised by them to a total height of 325 ft. 6 in. The remaining lock has a smaller lift, but its length is 1,380 ft., making it the longest in the world, the locks on the waterway across the isthmus at Panama being nearly 1,000 ft. in length.



Looking northward towards Lake Ontario from Lock No. 7 of the Welland Ship Canal. For the illustrations to this article we are indebted to the courtesy of the Department of Railways and Canals, Canada.

A glance at a map of Canada is sufficient to show the importance of the Welland Ship Canal, for it is a connecting link in the wonderful waterway provided by the Great Lakes and the River St. Lawrence. This penetrates far into the interior of the North American continent, the Straits of Belle Isle at the mouth of the St. Lawrence being 2,339 miles from the western end of Lake Superior. Formerly various obstacles prevented full use being made of it, but most of these have now been overcome. For instance, rapids between Lake Superior and Lake Huron have made necessary the construction of a short canal to enable lake steamers to pass easily from one to the other. This is known as the Sault Ste. Marie Canal, and is familiarly referred to as the "Soo." It is remarkable for the length of its locks, those on the American side of the waterway being 1,350 ft. in length, or only 30 ft. less than the longest lock on the Welland Canal, and also for the intensity of the traffic passing through it. In 1929 19,794 ships made use of the canal, their total cargoes of grain, coal, iron ore, copper ore, and other products amounting to 92,622,000 tons, or nearly 28,000,000 tons more than the freight borne in the same year by the Suez and Panama Canals combined.

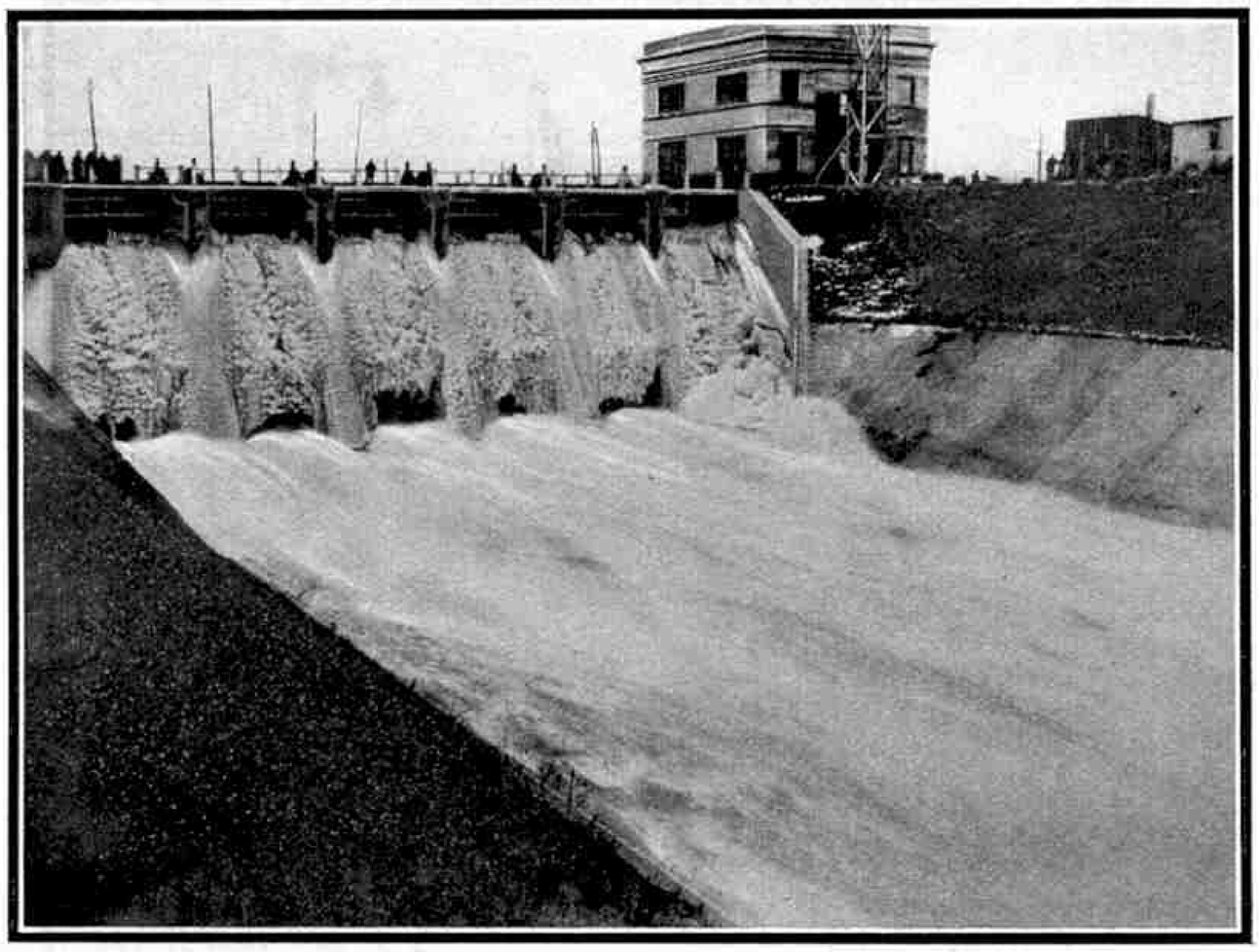
A greater obstacle than the rapids at Sault Ste. Marie formerly prevented navigation between Lake Erie and Lake Ontario. The difference in level between these lakes is nearly 330 ft., and half-way between the two, the short river connecting them plunges over the brink of the Niagara Falls, which on the Canadian side are 158 ft. in height. The existence of the Falls makes navigation of the Niagara River impossible, and vessels from the upper lakes can reach Lake Ontario and the St. Lawrence only by means of a ship canal across the peninsula.

The advantages of such a canal were realised as long ago as 1710, but it was not until 1824 that an effort was made to overcome the difficulty. In that year was begun the construction of a canal that climbed the slopes between the two lakes by means of 40 wooden locks. This remained in service for 20 years and was then taken over by the Government and enlarged, the wooden locks of the original canal being replaced by others of masonry, and their number reduced to 27. This second canal was followed in 1882 by a third that took a slightly different route. When it was opened the depth of this canal was 12 ft., but five years later the walls and banks were raised in order to increase

the maximum draught of vessels making use of it to 14 ft.

In the early years of the present century traffic on the Great Lakes increased rapidly in volume and larger vessels were introduced. It was then realised that reconstruction of the canal was necessary, and plans were drawn up for a waterway to have a depth of 30 ft. in order to enable it to accommodate the largest lake steamers. A start was made with the work in 1913, and this was continued until 1917, when war conditions made it necessary to close down.

After the signing of the Armistice work was resumed. Year by year it was pressed forward more vigorously, the number of men employed varying from 2,700 to 3,300; and a vessel passed through the entire length of the new waterway for the first time on 10th September, 1930. Navigation in the opposite direction was not allowed until spring of last year, certain portions of the old canal remaining in use until the close of navigation in 1930. From the head of Lake Superior to the eastern end of Lake Ontario the canal is now open to the largest vessels plying on the Great Lakes, but these cannot yet make their way down the St. Lawrence River to Montreal. Vessels with a draught of 18 ft. may now unload their cargoes at Prescott, 120 miles from Montreal, but until the canals in the course of the river have been enlarged, navigation below that port is restricted to ships drawing not more than 14 ft. of water.

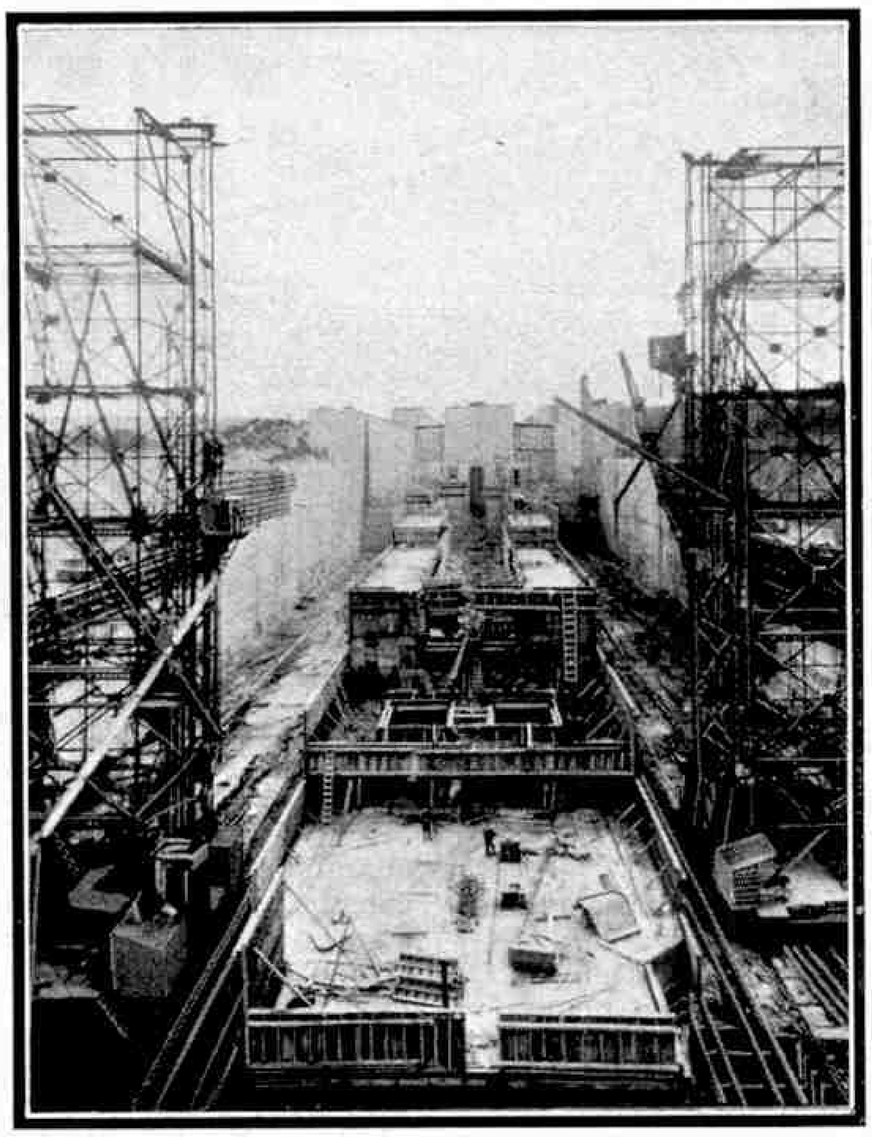


Testing the operating equipment of the weir that regulates the level of the water in Lock No. 1 of the Welland Ship Canal. It will be seen that this photograph was taken in wintry conditions.

The Welland Ship Canal may be divided into three distinct sections. The first is about six miles in length and begins at Port Weller, a great artificial harbour that has been constructed on the shore of Lake Ontario 10 miles west of the mouth of the Niagara River. The harbour itself is more than a mile in length and covers an area of 150 acres; and from it access to the canal is gained by means of the first of the eight huge locks that have been built. The waterway then continues over ground that rises gradually to a height of 140 ft. above the level of Lake Ontario. In this portion of the canal there are three locks, each of which gives a lift of 46 ft. 6 in.

In front of a vessel that has proceeded so far on its way to Lake Erie there now appears the steep hillside known as the Niagara escarpment, which rises to a height of nearly 190 ft. within a short distance, and has always been regarded as a formidable obstacle to the building of a canal across the Niagara Peninsula. The older waterways treated it very respectfully, climbing it by circuitous courses and with the aid of a large number of locks of comparatively small lift; but the new canal boldly makes its way straight up by means of four gigantic locks, each giving a lift of 46 ft. 6 in., the standard adopted in the construction of the Welland Ship Canal. Three of these are double locks, and form a continuous flight that is one of the most impressive features of the great waterway. The fourth is of standard construction and raises the canal practically to the level of Lake Erie.

The third section extends from the summit of the Niagara escarpment to Port Colborne, the southern outlet of the canal. This is a level section, 16 miles in length, and is cut off from Lake Erie by a guard lock in order to ensure that the depth of water in it shall remain undisturbed when the surface level of the lake changes. Guard gates have been constructed at the opposite end of the section, just above the last of the four locks by means of which the canal climbs the escarpment. Their purpose is to retain the water in the portion of the canal at summit level if the gates of the lock below them are made useless by accident. They are not likely to be required for this purpose, however, for as an additional precaution the gates of the lock they protect have been made double.

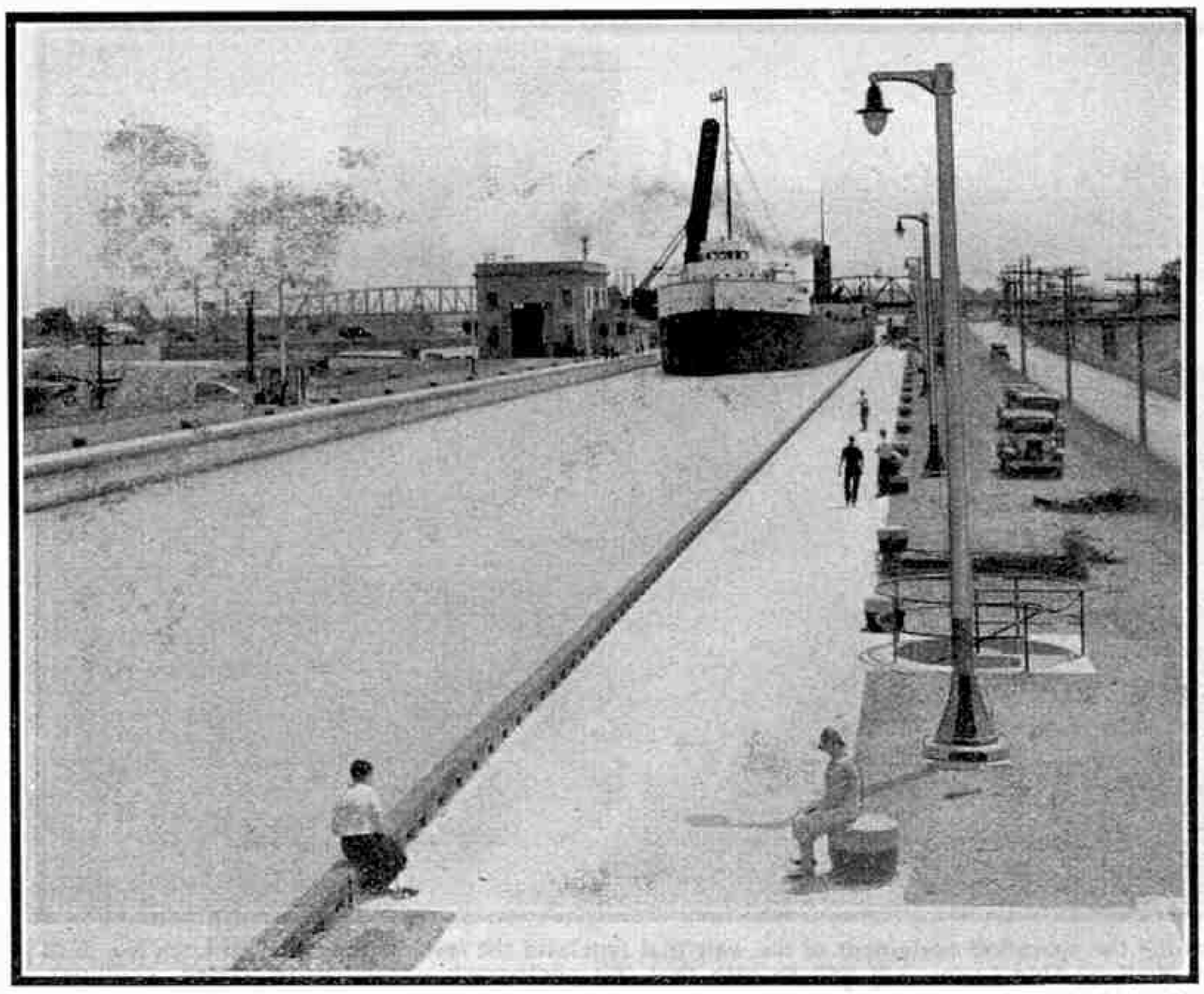


Building the giant concrete walls of the twin locks by means of which the Welland Canal climbs the Niagara escarpment. These locks form a continuous flight giving a total lift nearly equal to the height of Niagara Falls.

In constructing the canal the course of the previous waterway has been followed to a great extent, and in many places the provision of a deeper and wider waterway has practically only involved dredging. Several awkward bends have been straightened out, however, and from Lake Ontario to the top of the Niagara escarpment the canal follows a new and more direct line. The chief aim in making the alterations has been to speed up traffic. It is for this reason that the number of locks has been restricted to eight, one of which is the guard lock at Port Colborne; and the decision to reduce their number has meant building locks larger and with much greater lifts than those of the previous waterways. This course was necessary also in order

to make the canal suitable for large modern vessels.

The seven locks by means of which the difference in level between Lake Ontario and Lake Erie is overcome are among the largest in the world. Each is 859 ft. in length, of which 820 ft. is available for the accommodation of vessels passing through, and 80 ft. in width; while the minimum depth of water on the sills is 30 ft. Their gates are of the double leaf type, and each of the leaves used at the lower ends weighs 490 tons. In spite of their enormous size, and the massiveness of their gates, the locks may be filled or emptied in eight minutes, and the time required to pass through the canal is from six hours to eight hours, instead of the 16 hours to 18 hours occupied by vessels passing through the old waterway.

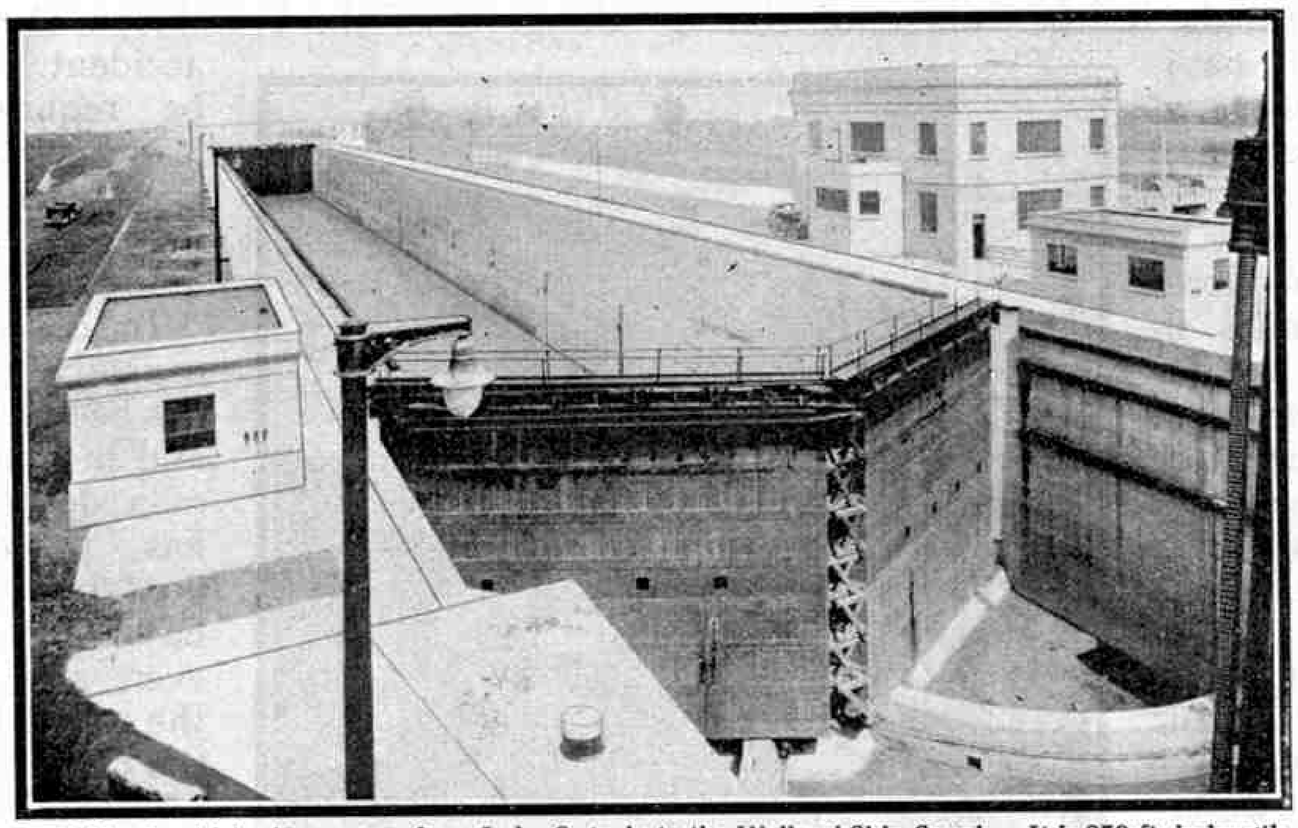


Another view of Lock No. 7, looking towards Lake Erie. The vessel entering the lock is the "Westmount." She is 529 ft. in length and carries a load of 10,000 tons of iron ore.

The guard lock at the Lake Erie end of the canal is not so deep as the other locks, for it will not be required to give a lift of more than 12 ft. As we have said, however, its length of 1,380 ft. gives it the distinction of being the longest in the world. Its nearest rivals are two of the locks on the American side of the canal at Saulte Ste. Marie, between Lake Superior and Lake Huron, and the lock at Ymuiden, in Holland, on the ship canal between Amsterdam and the North Sea, the lengths of these famous locks being 1,350 ft. and 1,312 ft. respectively.

Building the locks was a tremendous task, for their walls of monolithic concrete are stupendous in size. On each side they extend to a length of more than 1,000 ft. On the crest they are 16 ft. in width, and the standard width at their base is 46 ft. Each wall is 82 ft. in height, for the depth must be sufficient to allow for the minimum draught of 30 ft. in addition to the lift of 46 ft. 6 in. The floors of the lock also are of concrete and take the form of inverted arches. In the case of the lock giving access to the canal from Port Weller, the floor rests on solid rock, to which it is anchored by means of heavy steel rods grouted into the rock itself.

In the side walls of the locks are various tunnels and passages. The most important of these are the main culverts, one in each wall, by means of which water enters and leaves the locks. These culverts are so large that a modern locomotive with a train of eight coaches could easily be accommodated in one of them. They are 14 ft. in width and 16 ft. 6 in. in height, and the water flowing through them enters the locks through large openings in the side walls.



Lock No. 1, which gives access from Lake Ontario to the Welland Ship Canal. It is 859 ft. in length and 80 ft. in width, and gives a lift of 46 ft. 6 in., the standard adopted for the seven lift locks of the Canal. The floor of this lock rests on a foundation of solid rock.

The three locks in the first section of the canal and that at the top of the escarpment are similar in construction, but a different plan has been adopted in building the three that form the continuous flight to which reference has already been made. These are double, for separate sets of locks have been provided for vessels passing up and down the canal, an enormous concrete wall 60 ft. in width separating the members of each pair.

The remarkable twin locks of the canal form a series of steps up the escarpment that give a total lift of 139 ft. 6 in., or only 18 ft. 6 in. less than the height of the Canadian side of the Niagara Falls. They are impressive in all circumstances, but were doubly so before water was allowed to enter them, for then their full depth could be realised. Anyone standing on the lower gate of one of the uppermost pair and looking northward toward Lake Ontario then had behind him an enormous chasm, 82 ft. in depth, that extended as far as the upper gates 859 ft. away. In front was a sheer drop of 130 ft. to the bed of the middle lock, and from the lower gate of this there was a further drop of 130 ft. to the bottom of the lowest of the three locks forming the flight. On one side of the canyon-like depths could be seen the enormous concrete side wall, and on the other the equally impressive mass of concrete erected to shut off the three similar locks on the opposite side of the canal.

The supply culverts in the walls of the locks of this triple flight are continuous, water flowing from one being led directly into the next below it. Two of the locks are founded on rock, and for this reason the thickness of their side walls is less than in the ordinary single locks; and the enormous masses of concrete have been anchored in the same manner as the floor of the lock leading from the harbour at Port Weller.

The gates with which the great locks are closed are of enormous size and weight. They are built of steel and each consists of two leaves. Those employed at the lower end of the lake are 82 ft. in height, and each leaf weighs nearly 490 tons. The upper gates are not so large, their height being 35 ft. 6 in. and the weight of each leaf about 190 tons. The gates of the guard lock at the southern end of the canal are 44 ft. 6 in. in depth.

The leaves of the gates are of the horizontal girder type, sheathed on both sides, and have a standard thickness of 5 ft. All are 48 ft. in length. The largest leaves used at the lower ends of the locks contain 19 girders. These are connected by vertical posts at their ends, and also by five sets of vertical diaphragms. On the upstream side the sheathing panels vary from $\frac{7}{16}$ in. to $\frac{5}{16}$ in. in thickness. Those on the downstream side have thicknesses ranging from $\frac{7}{16}$ in. to $\frac{5}{8}$ in., the heaviest panels in both cases being at the bottom of the leaves. The lower part of each leaf is an air chamber, the depth of 47 ft. 6 in. from the top girder being filled with water when the lock is filled, and draining itself when the lock empties. The size of the water chamber, and therefore the total weight of each leaf, has been calculated to give it sufficient buoyancy to keep it practically afloat in order to relieve the pressure on the hinges.

The leaves swing on nickel steel pins mounted in castings grouted into the concrete floor of the locks, and the upper hinges are anchored to steel frames embedded in the walls. In spite of their enormous size and weight they may be moved easily and readily by means of electrical machinery controlled from buildings placed at the ends of the locks, and no further effort is needed to swing the gates on their hinges than the turn of a switch.

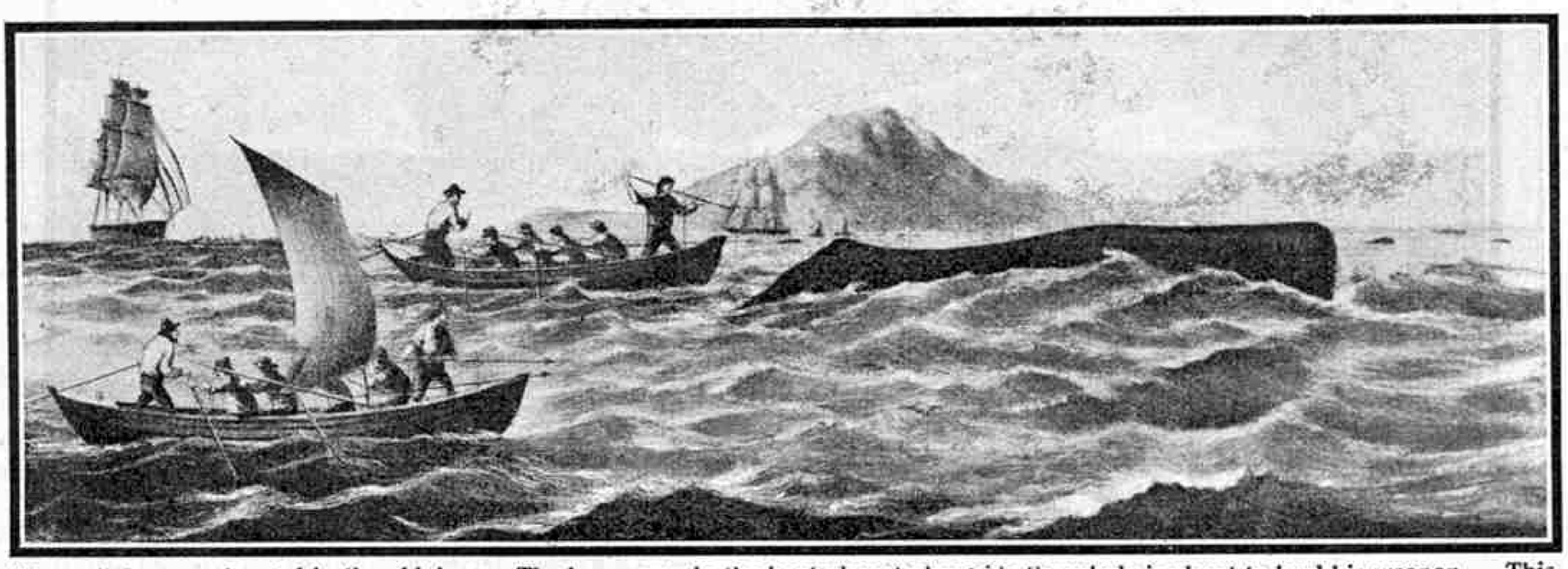
Each gate was erected in its lock and very (*Continued on page 770*)

The Romance of Whaling

II.—Hunting from the Arctic to the South Pacific

ONE of the most remarkable features of the history of whaling is the manner in which the principal scene of operations has moved from sea to sea as the supply of whales has become depleted. In the previous article in this series we told how the Basque whalers of north Spain eventually had to seek their prey further afield, and by the year 1600 were hunting whales as far north as Iceland and even off the coast of Newfoundland. British and Dutch whaling ships also were operating in these waters.

The proximity of the whalers to the little-known Polar regions stirred the imagination of the more adventurous spirits among them, and more than one whaler became famous as an Arctic explorer. One of the earliest of these was William Baffin, of London, who in 1613 commanded one of the English vessels engaged in the Greenland fisheries and in the whale hunting off Spitzbergen. In later voyages Baffin completed the work of Davis, an earlier explorer, in exploring the Hudson Strait. He discovered the land that now bears his name, and the great bay that was subsequently called Baffin Bay and many years later became an important whaling ground.



How whales were hunted in the old days. The harpooner in the boat almost alongside the whale is about to hurl his weapon. This illustration and the lower one on the next page are reproduced by courtesy of "The Compressed Air Magazine."

Considerable rivalry in developing the Arctic existed during the 17th century between the English and the Dutch, whose boats came in fleets to the Polar seas for whaling and seal fishing. On one occasion in 1618 the Dutch captured an English whaling ship and took it to Amsterdam. The Dutch Government intervened, however, and the vessel, cargo and crew were restored; but it is interesting to note that the captors were granted an award for their daring! Spanish, Norwegian, Russian and French merchants also sought a share in the industry, and eventually the whaling areas around Spitzbergen were divided among the different national whaling fleets.

The whaling ships of the period were stoutly built wooden sailing ships that could stand up to any weather, their hulls being covered on the outside with copper or iron sheeting to protect and further strengthen them against collisions with the ice. When a group, or "school," of whales was sighted, the ship sailed as swiftly as possible in pursuit and when fairly near the ship's boats were lowered and manned, and rowed hard after the prey. In the prow of each boat, which was little more than a cockleshell, the harpooner stood alert, ready to plunge his weapon into the first whale to which the boat drew close enough. His harpoon was a crude affair and consisted simply of a flat triangular piece of iron terminating in a sharp prong or barb. The iron was secured firmly to one end of a wooden handle or pole, and to the other end of this was attached a long rope that was coiled in an open cask in the forepart of the boat. The harpoon was used merely to "fasten" the whale, and the purpose of the rope was to allow him plenty of play during his efforts to escape, the free end of the rope being firmly secured in the boat.

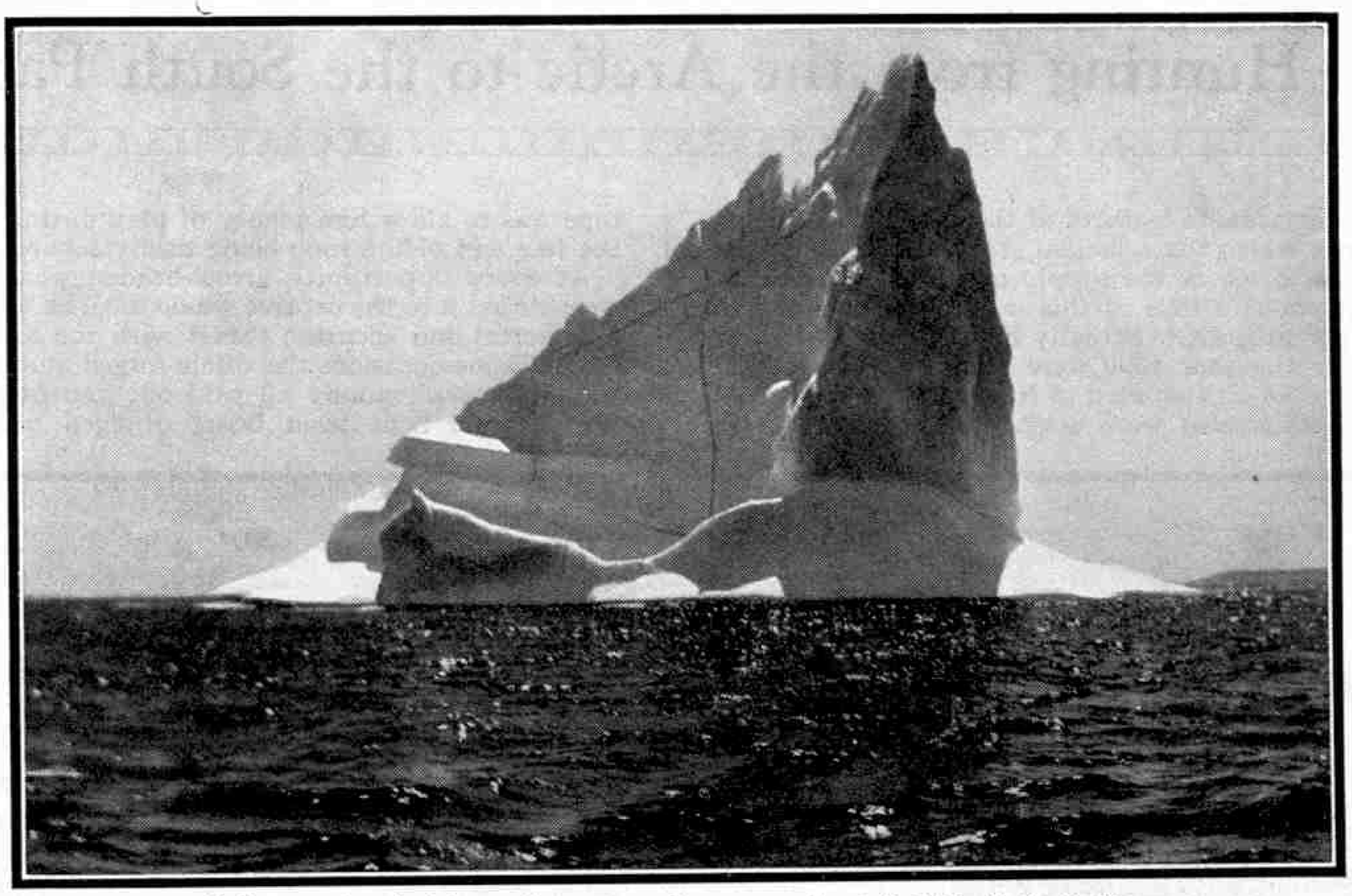
Captain William Scoresby, a famous 19th century whaler.

At every opportunity arrow-headed weapons called "lances" were thrust into the captive whale until he was killed. Sometimes a powerful and accurate thrust with the first lance proved fatal, but on some occasions the whale forged ahead so speedily that the whale-line was rapidly all paid out and finally had to be cut to prevent the boat from being dragged under the water. The harpooner who was unfortunate enough to lose both whale and harpooning gear was usually very unpopular with the whaling skipper for many days afterwards. A hole was lanced in the tail of the dead whale and a rope passed through this and knotted. The whale was then towed to the ship and moored alongside by ropes while the thick layer of blubber was cut away and hoisted aboard the ship, where it was placed in tanks. The carcase of the whale was then released and sank immediately.

The Dutch were very enterprising. They found by experience that, owing to the smallness of their ships, these were full after cutting up two or three whales, and they developed a system of towing the dead whales to Amsterdam Island, where they had established a village called Smeerenburg, or Blubbertown, and dealing with them there. By this method only the valuable products obtained from the whales had to be taken aboard the ships, which were thus able to carry cargo representing very many whales. Whaling factories equipped with boilers, tanks and coolers were erected on the island, and on arrival the dead whales were "flensed" or cleared of blubber and bone, the blubber being cut up and placed in the boilers. The oil obtained from the blubber was run into the coolers and later stored in barrels. During the summer months the island presented a scene of great activity, but at the close of each season the whaling factory employees were taken back to Holland.

During some seasons more than 100 whaling ships could be seen around Spitzbergen. As a result of this intense persecution the whales eventually forsook that area and fled westward to the waters around Greenland. The whalers had no alternative but to follow them, and one by one the Dutch factories were dismantled and transferred to Greenland. With this transference of operations the mutual trade agreement between the nations lapsed and, encouraged by a Government bounty of 20/–, and later 40/–, a ton to every ship of over 200 tons engaged in whaling, the number of British whalers increased. Aided also by a decline in the Dutch whaling trade, the British industry prospered increasingly and attained the height of its prosperity between 1752 and 1820, when as many as 250 vessels were employed. London, Hull and Whitby were the chief British whaling ports at that time.

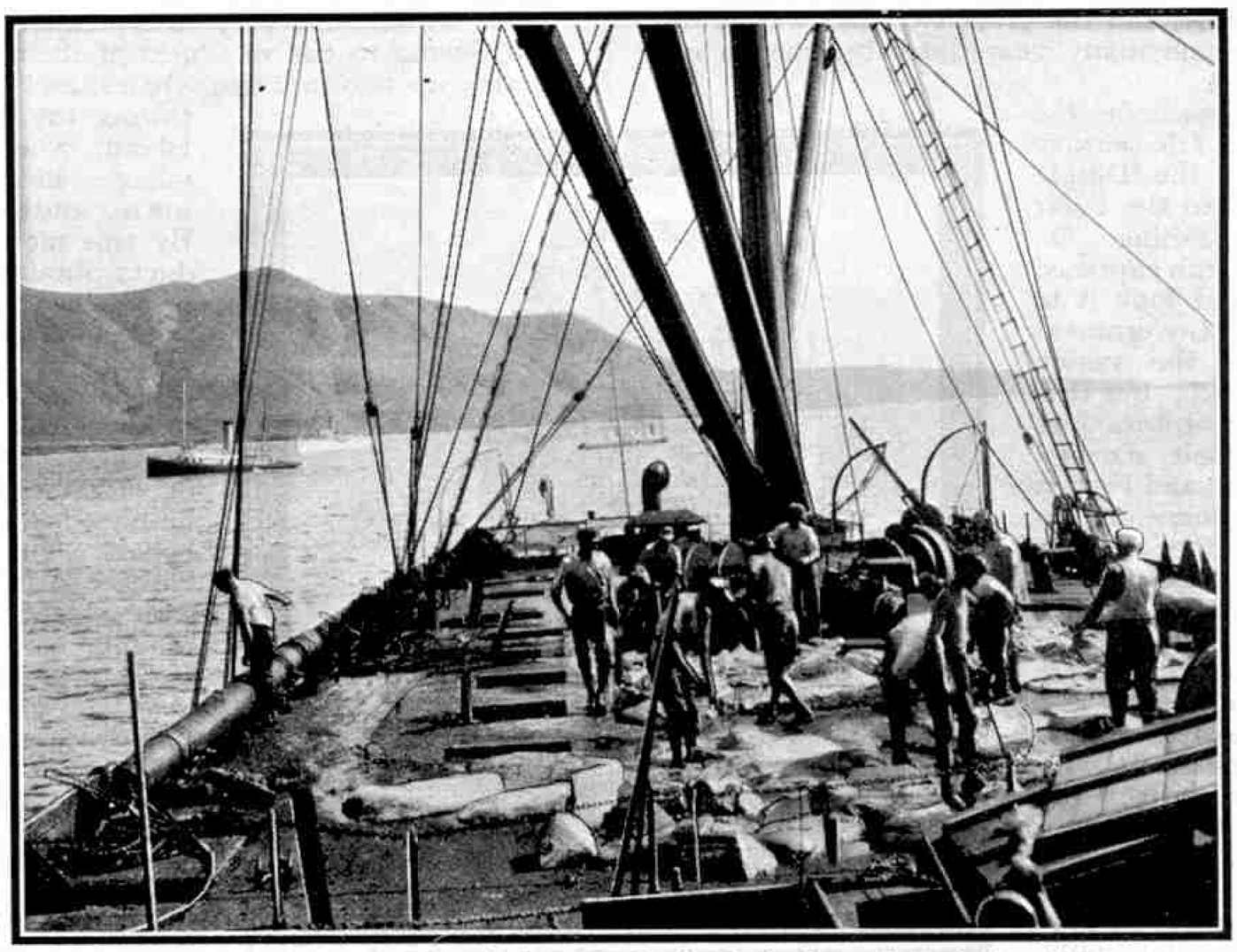
A famous British whaler of the early 19th century, who became equally famous as an Arctic explorer, was William Scoresby, who went to sea when only 20 years of age, and in 1806, when in command of the "*Resolution*," sailed as far North as Lat. 81° 30′. Scoresby always managed to reach the whaling ground in quicker time than his rivals, and, when he so chose to do so, was able to penetrate further into the ice. He managed to do this by discovering the advantage of flat sails and by bringing his weights well down by filling his oil casks with water as ballast, and packing them with shingle. Thus, instead of starting light on his voyage he was in the best of trim and was able to quickly beat to windward and so reach the fishing ground in "double quick time."



Icebergs such as that shown above are a serious menace to whaling ships in the Arctic.

On the occasion on which he reached Lat. 81° 30′, a position beyond the ice barrier and the farthest North ever reached by a sailing vessel in these seas, there was no ship within 350 miles of the "*Resolution*." It is pleasing to learn that fortune favoured the brave venture, for in the following 32 days the ship caught 24 whales, as well as seals, walruses, etc., so that the voyage proved to be one of the most profitable he had undertaken. Scoresby's successful whaling was often the envy of less fortunate skippers. In 28 whaling seasons in the far North he brought home cargoes of whale oil and bone to the total value of £150,000.

Scoresby invented many devices that came into general use on ships engaged in Arctic service. Probably the best known of these inventions is the "crow's nest," or look-out tower, that soon became a feature of every whaling ship. In Scoresby's day the crow's nest took the form of a canvas-covered framework placed above the topmast cross-trees, and entrance to it was obtained by a trap-door in the base, which was reached by climbing up the rigging. When a whaling ship was in the far North the skipper, armed with telescope and speaking trumpet, often spent long periods in the crow's nest, noting the movements of the ice through which the ship had to thread her way. On such occasions Scoresby often remained in the crow's nest for 12 hours at a stretch.



Cutting up the blubber of a whale on the flensing deck of a modern whaling ship.

As long ago as 1719 a few enterprising Dutch whalers had sailed as far as Davis Strait on the west coast of Greenland, and discovered there an abundance of whales. From that time a minor proportion of the Dutch whalers regularly visited this new whaling ground, but the British and the remainder of the Dutch whaling ships did not pay serious attention to it until the supply of whales around the east coast of Greenland became noticeably less about 100 years later. Gradually history repeated itself and the scene of operations moved again. The whalers had hardly begun to concentrate on Davis Strait when, in 1819, a British naval expedition headed by Sir John Ross penetrated the Strait and confirmed the existence of the great bay reported by Baffin 200 years previously, and the fact that it contained numerous whales. Soon the more adventurous of the whalers were operating in the icy waters investigated by Ross, and in time they penetrated even farther North.

The numerous icebergs in Davis Strait and beyond proved a serious menace to the whaling fleets and took heavy toll of them. In 1819, for instance, 10 out of 63 ships were lost, and in 1822 seven out of 60 vessels failed to return home. These losses were serious enough, but they were insignificant compared to the disaster that overtook the whaling fleets in 1830. By that time the Davis Strait had been hunted almost clear of whales, and many of the ships were sailing regularly up the eastern side of Baffin Bay and across Melville Bay.

In 1830 the British whaling ships set off from their home ports during March as usual, and after prolonged battling with head winds reached the entrance to Davis Strait late in April. The ships slowly made their way up Baffin Bay, passing from almost ice-free waters to an accumulation of moving ice that hindered their progress for almost a week. When Melville Bay was reached about the middle of June, the whalers found it exceedingly crowded with ice floes driven there by a strong south-west wind. Beyond this congestion of ice was the open water of the bay and an abundance of whales. The ambition of every whaler was to be the first to reach the whaling ground, and in spite of the formidable array of ice the ships were soon seeking a way through. At length the whaling ship "*St. Andrew*," of Aberdeen, discovered an opening to the west, and 22 other ships were able to follow her through to open water before the ice closed and created a barrier that the other ships vainly tried to penetrate.

For just over a week all went well with the 23 ships, but on the 19th June a strong S.W.W. gale arose and the ice about the ships began to pile up. Six of the ships, including the "*St. Andrew*," sheltered under the lee of a huge ice floe in very shallow water, ranging themselves close together in single file. The gale increased steadily and on 24th June the ice began to press severely against the ships. "In order to relieve this pressure," relates Mr. Keble Chatterton in his interesting book "*Whales and Whaling*," "hands were set sawing the ice so as to form a wet dock, but soon came a great floe which nothing could withstand. Lifting up the "*Eliza Swan*," the floe hurled her against the "*St Andrew's*"

bow with such force as almost to wrench the former's mizzen mast out of the ship; and then the floe passed from under, damaging both stem and keel. It next struck the "*St. Andrew*" amidships, snapping about twenty of her timbers, and then passing along the line dashed against the "*Baffin*," "*Achilles*," "*Ville de Dieppe*" and "*Rattler*" with such energy that within fifteen minutes these four strongly built, specially fortified whalers designed for Arctic work, were for the most part converted into mere fragments of wood. . . The "*Ville de Dieppe*," partly filled with water, was the least unfortunate, for she touched bottom, remained upright during the next fortnight, and from her were salved stores and provisions. Some were also taken from the "*Baffin*," and boats were hauled on the ice to form some sort of shelter."

Similar misfortunes overtook many of the other whaling ships, including some of those that had been compelled to remain south of the ice barrier. "And then on that glacial surface," says Mr. Chatterton, "a thousand seafarers set to work making themselves as comfortable as they could with bits of sail as tents." Although every officer and man of the wrecked ships landed safely on the ice, some of them died from fatigue and exposure to the cold during the months in which they were encamped. By the beginning of September the "*St. Andrew*" and the "*Eliza Swan*" and several other ships that had survived the storm succeeded in reaching open water.

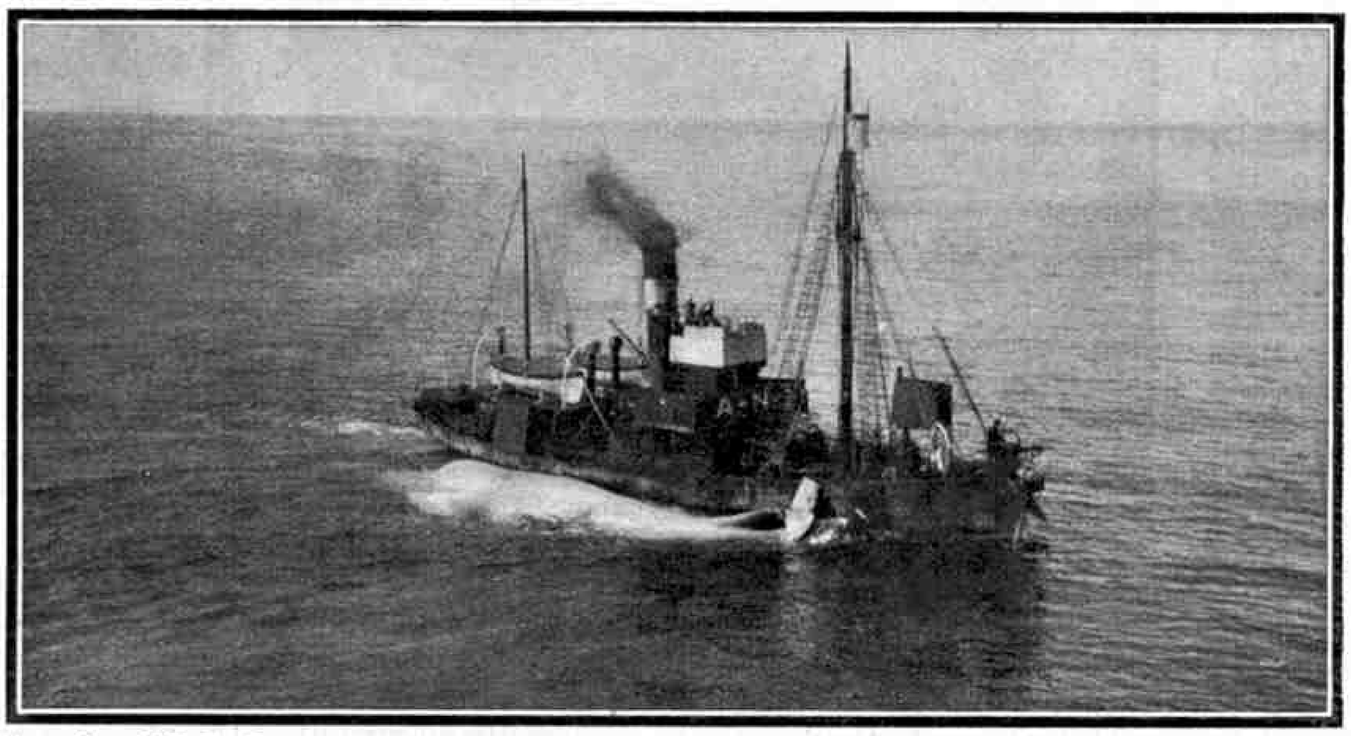
The survivors included the sailing ship "*John*" of Greenock, with the crews of the wrecked "*Letitia*" and "*Princess of Wales*" on board, but she remained fast in the ice. The captain died, and the mate took charge. He began to fear that the ship would be icebound throughout the approaching winter, and eventually he took one of the boats and, accompanied by 12 other men, set out in search of some of the Danish settlements. Shortly after their departure the ship began to move, and in a few hours she had sawn her way through the ice to fairly open water. Although the mate had taken with him the ship's charts, the remainder of the crew aboard decided to navigate the ship during the day as best they could and to anchor each night. In this way the "*John*" slowly made her way south, but the navigators became over-confident. One evening the man on watch wrongly assumed that a line of breakers he observed ahead was caused by a stream of ice, and he kept the ship on her course. "The next thing was that the '*John*' was ashore," relates Mr. Chatterton, "and although built of teak she was a total wreck by the morning. Fortunately there were sighted the '*Eliza Swan*' and the '*Duncombe*' of Hull, who picked up the crew and brought them safely home."

The disaster dealt a severe blow to the British whaling industry, and by 1849 the number of British whaling ships employed had decreased to 14. The decline in Arctic whaling extended also to foreign ships, for the perils of hunting whales in the far North, and the favourable reports brought by merchant ships trading in more southerly waters, led enterprising whalers to sail south instead of north in search of profitable cargoes of whale oil. Sperm whales were sought and found in large number in the neighbourhood of the western islands of the Azores and in localities as far apart as the coasts of Africa and Brazil; while the waters around Falkland Island, in the south Atlantic, proved a valuable hunting ground. Whaling ships from North America had been hunting sperm whales in the Atlantic from as early as 1726, and they did not look with favour upon the increasing intrusion of foreign whalers.

Steam-driven saws are now used to cut up the skull, jaws and backbone of a whale after they have been stripped of flesh. The above photograph shows the bones of the skull being dragged to the boilers after being cut into convenient lumps.

The first British whaling ships to take up the regular hunting of sperm whales in the Atlantic were equipped in 1775 by a London whaling company founded by Samuel Enderby, a merchant of the city. The Enderby company became famous for its pioneer work in seeking new whaling grounds. In 1788 an Enderby ship named the "*Emilia*" crossed the Atlantic and, rounding Cape Horn, gained the distinction of being the first whaling ship to hunt Sperm whales in the Pacific. The "*Emilia*" did not stay there long, but such was the abundance of whales she discovered that she returned home with a full cargo of whale oil. When the success of the "*Emilia's*" trip became known other British whalers made the long voyage to the newly discovered whaling ground. The North American whalers soon learned from this activity that a vast and unexploited whaling area existed almost at their door, and they visited it in rapidly increasing numbers. By their long experience of sperm whaling in the Atlantic the American skippers and their crews were very efficient, and once they realised the richness of the Pacific as a whaling ground they explored it thoroughly, voyaging as far to the west as New Zealand, where a valuable whaling ground was discovered.

In April 1832, the American whaling ship "*Erie*," of Newport, Rhode Island, inaugurated whale hunting in the bays of the south island of New Zealand. After a voyage lasting three years she reached home in June 1835 with a cargo of 2,000 barrels of oil. The example set by the "*Erie*" was followed by several American ships during the next whaling season, and valuable cargoes of oil were obtained. A few British and French whaling vessels also began to visit New Zealand waters.



A modern Whale Catcher towing a captured whale to the floating whaling factory. The illustrations on this page are reproduced by courtesy of Sir W. G. Armstrong Whitworth & Co. Ltd., and the "Discovery" Committee, London.

The abundance of whales around the south island of New Zealand tempted the more adventurous of the American whalers to hunt still farther south, and thus began the gradual movement of the whaling industry towards the Antarctic, which is now the scene of the most important whaling operations, and is visited by the whaling ships of many countries.

From California to the new whaling grounds meant for the American whalers a very much longer absence from home than when they were content to hunt in the eastern waters of the Pacific, and many of the whaling ships that made the long and monotonous voyage to the south island of New Zealand were away for two or three seasons before returning home. The full and valuable cargoes obtained, and the important fact that the new ground had not yet become well-known to the whalers of European countries compensated for the prolonged trip. In the next article we shall describe the equipment of these whaling ships of a century ago.

II.—SIR FRANCIS DRAKE

WHEN Queen Elizabeth succeeded to the throne of England in 1558 one of the first tasks she undertook was that of increasing the strength of the Navy, which had declined seriously since the time of Henry VIII. The war with France was brought to a close, and Spain now came into prominence as the great enemy. A remarkable wave of enthusiasm for the sea arose, and a host of privateers appeared in the Channel, attacking every Spanish ship they encountered, and making large profits out of their captures. Soon many of the more adventurous privateer captains extended their activities beyond the Channel. There is no doubt that Elizabeth secretly encouraged their marauding enterprises to the West, and had a financial interest in many of them. Among the outstanding figures in this company of "gentlemen adventurers" was Francis Drake.

Drake was born at Crowndale, a small village in Devonshire, in 1541. He was brought up in a seafaring atmosphere, for while he was still very young the family removed to Plymouth, where his father obtained a chaplaincy in the Royal Navy, and where they made their home in one of the old war hulks in the harbour. Unfortunately this appointment was terminated in 1553 when the Catholic Mary became Queen, and the family was soon reduced to such poverty that an opportunity was taken to apprentice the boy to the master of a coasting vessel trading with French, Spanish and Dutch ports. Life aboard such a ship in those days was rough even for hardened and experienced sailors, but the boy rose to the occasion and served so well and so faithfully that when his master died a few years later he bequeathed the ship to him. For some time Drake continued trading on the lines followed by his late master, and with considerable success.

In 1558 the Protestant Elizabeth succeeded to the throne, and the Catholic King of Spain, Philip II, in an excess of religious zeal closed all Spanish ports to English ships to keep the Protestant religion out of his country. This restriction seriously hindered Drake's trading activities, and selling his ship he engaged with John, afterwards Sir John Hawkins, and his brother. John Hawkins had just completed a successful voyage to the West Indies during which negro slaves had been collected and exchanged for Spanish treasure and merchandise, a form of trading that Philip II had strictly forbidden his American colonies to carry on with foreigners. Philip soon removed his restriction on English shipping, and Drake then sailed as purser in one of the Hawkins ships to St. Sebastian, Spain.

Meanwhile John Hawkins carried out a second successful slaving voyage that caused the King of Spain to protest to Elizabeth and resulted in Hawkins being forbidden to carry out a similar trip in the following year. The attitude of Spain met with little sympathy in this country, however, and a trading expedition led by Hawkins left England for the West Indies late in 1567. The expedition consisted of six vessels, one of which was under the command of Drake, and on the way to Guinea the fleet destroyed several Portuguese trading ships in revenge for similar treatment to some English ships. When about 500 negroes had been collected at Guinea Hawkins sailed for the Spanish Main, where he traded his unfortunate captives for treasure and then sailed for home.

A hurricane damaged his ships so much that he put into the harbour of San Juan de Ulloa, now known as Vera Cruz, for repairs. Hawkins obtained from the Spaniards an agreement not to molest him, but they treacherously attacked him. A desperate fight followed, Hawkins escaping with two of his ships. This conflict gave Drake his first taste of Spanish methods, and so great was his anger that he resolved to wage continual war against Spain.

Portrait of Drake from a contemporary print. This and the upper illustration on the opposite page are from prints in the possession of T. H, Parker Ltd., 28, Berkeley Square, London, by whose courtesy we are enabled to reproduce them.

Drake obtained from Queen Elizabeth a privateering commission, and gathering together a band of enthusiastic adventurers he made three voyages to the West Indies. The first two of these trips were chiefly to spy out the land and to enable him to form a plan of action. He decided to raid the town of Nombre de Dios, on the Caribbean side of the Isthmus of Panama, where the Spaniards periodically collected the mineral wealth obtained from the mines of Peru and Mexico for export to Spain; and he carried out this plan when on his third voyage in 1572.

The expedition consisted of two small ships with crews totalling 73 men and boys, and three collapsible pinnaces in which to row ashore. At Nombre de Dios the expedition was joined by a third ship, and the crew of this were left in charge of the three ships, while Drake and his men went ashore by moonlight. They took the Spaniards by surprise, and although Drake was wounded in the leg, the party succeeded in reaching the King's treasure house. As they stood before the entrance Drake told his men that he had brought them to the mouth of the "Treasure of the World," and that it was their own fault if they did not make the most of it. He then ordered them to break open the door, but had hardly given the command when he fainted from loss of blood. The uproar created in the town by the English invasion had somewhat unnerved Drake's men, and without risking an onslaught on the treasure house they carried him back to the boats.

The abandonment of the attack when victory was almost within grasp enraged Drake, and when he had recovered from his wound he consoled himself by attacking and burning Porto Bello, where he captured many Spanish ships and seized a great Spanish mule train of treasure. Before leaving the port Drake persuaded some friendly Indians to lead him to the highest point of the Isthmus where, by climbing a high tree, he obtained his first glimpse of the Pacific Ocean. It was a thrilling moment, for he was the first Englishman to view this sight, and his love of adventure stirred him to pray "Almighty God of His goodness to give him life and leave once to sail in an English ship in that sea." Laden with treasure the expedition returned home and reached Plymouth on 19th August, 1573. He landed at Plymouth on a Sunday morning, and we are told that the whole congregation left church in the middle of the sermon and rushed down to the waterside.

After four years of quiet life ashore Drake organised another

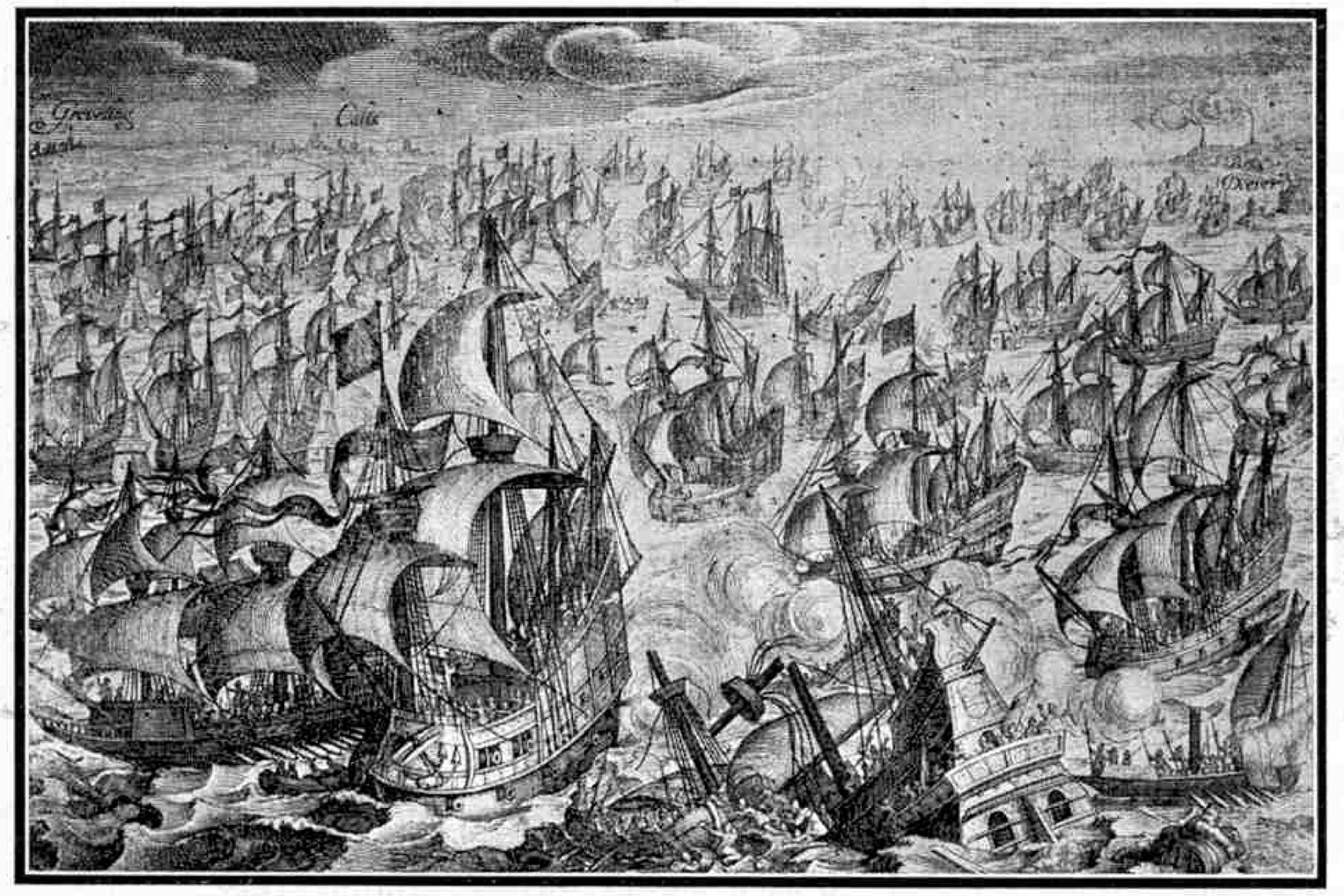
expedition. He revealed to Elizabeth his plan to sail through the Strait of Magellan and raid Panama and the South Seas, and it is stated that the Queen gave him 1,000 crowns towards the expenses of the expedition on condition that her connection with the affair should be kept secret. At that time England was keenly interested in exploration, and Drake had no difficulty in raising the necessary funds and obtaining men and equipment. On 15th November, 1577, the expedition sailed from Plymouth, but bad weather damaged one of the ships and caused a return to port for repairs. A month later the expedition set out again on a voyage that was destined to bring its commander fame and fortune.

Drake's fleet consisted of his flagship the "*Pelican*," afterwards renamed "*Golden Hind*," a ship of 100 tons and armed with 18 guns; the "*Elizabeth*," 80 tons and 16 guns; the "*Swan*," 50 tons and 5 guns; the "*Marigold*," 40 tons and 16 guns, and the "*Benedict*," renamed "*Christopher*," 15 tons and one gun. The crews totalled about 160. The expedition encountered a series of violent storms that induced Drake to abandon the "*Swan*" and the "*Christopher*" in order to make his fleet more compact. He forced his way through the Strait of Magellan, taking three weeks to make the passage, and then two disasters occurred. The "*Marigold*" sank with all on board, and the "*Elizabeth*" became separated from the "*Golden Hind*," and finally returned home alone. Drake was now left with only one ship. He did not allow this fact to worry him, however, and made straight for Valparaiso, and there had his first success in the capture of a large Spanish galleon laden with gold and wine. After raiding various towns along the coast he captured another treasure ship, and then made for home across the Indian Ocean and round the Cape of Good Hope. He arrived at Plymouth in September, 1580, thus being the first Englishman to circumnavigate the globe. In the following year Drake brought the "*Golden Hind*" to London, and on 4th April, after a great banquet on board, Elizabeth knighted him.

An interesting glimpse of Drake aboard the "*Golden Hind*" is given in a letter written by a Spanish captain whom Drake captured and later released: "He is about 35 years old, of small size, with a reddish beard," writes the captain," and is one of the greatest sailors that exist, both from his skill and his power of commanding. He has with him nine or ten gentlemen, younger sons of the leading men in England, who form his council. He has, too, all possible luxuries, even to perfumes, many of which he told me were given him by the Queen. None of his gentlemen sits down or puts on his hat in his presence without repeated permission."

Relations between England and Spain became more and more strained, and the two countries rapidly drifted towards war. In 1585 Drake sailed again, this time with a commission from Elizabeth, and descended on the West Indies, captured San Domingo, held Cartagena to ransom, and returning home by way of Florida plundered the Spanish settlement of St. Augustine, and took on board the survivors of Raleigh's colony of Virginia.

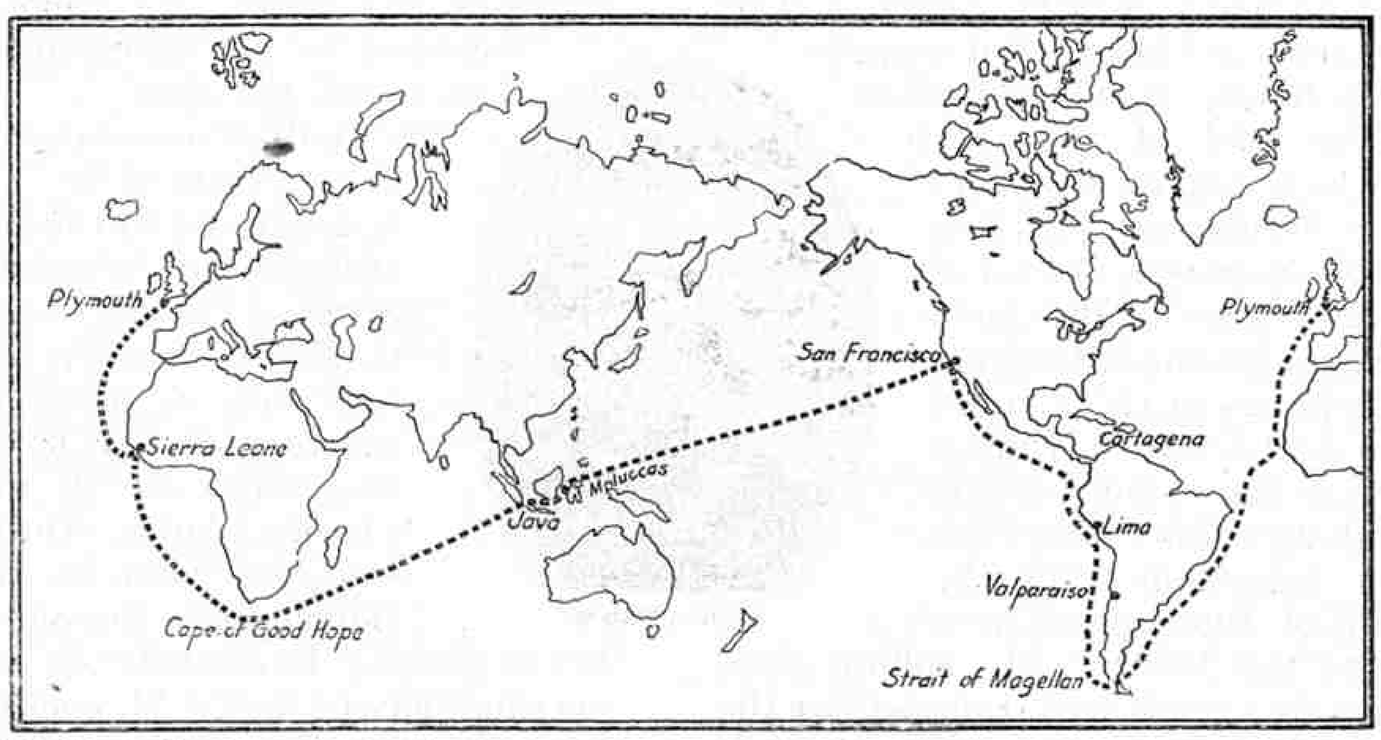
By this time war with Spain was an actual fact, although it had never been formally declared. In 1587 Drake, with the rank of Admiral, was sent out to discover as much as possible of the Spanish preparations, and to do all he could to prevent the concentration of the fleet that Philip was collecting. He sailed on 2nd April and made for Cadiz, the chief Spanish naval base, where were assembled several big galleons and a number of storm-ships. After a fierce encounter the desperate resistance of the Spaniards was overcome, and Drake burned and destroyed to his heart's content. The Spanish losses amounted to some 12,000 tons of valuable shipping; Drake had indeed "singed the King of Spain's beard"! On his way home Drake captured the "*San Felipe*," Philip's own treasure ship, with a cargo of enormous value and documents regarding the Spanish East India trade that were of great importance in the subsequent decision to form an English East India Company.



Drake's action off Gravelines during the Armada fight in 1588.

Drake's devastating attack on the partly assembled Armada delayed its completion for a year, and matters were further complicated by the death of the Marquis of Santa Cruz, the most experienced of all the Spanish admirals. Philip appointed in his place as commander the Duke of Medina-Sidonia, who had little knowledge of military and less of naval warfare. The Duke persisted that he was unqualified to command the expedition, but for some extraordinary reason the king insisted on his taking the post. Finally the Armada sailed from Lisbon about the middle of May, but was forced to put into Corunna on account of a severe gale, coupled with bad provisions and shortage of water. It was not until 12th July that the fleet was able to set out once more.

The English fleet ready to oppose the Armada was under the command of Lord Howard of Effingham, with Drake as Vice-Admiral. It consisted of 197 ships made up of 34 royal ships of various sizes, 34 merchantmen, 30 ships and barques provided by the City of London, 33 barques and other ships, 43 coasting vessels provided by Elizabeth, and 23 voluntary ships. The number of men who actually took part in the engagement was probably about 10,000.



Map illustrating the route taken by Sir Francis Drake on his famous voyage round the World, 1577-1580.

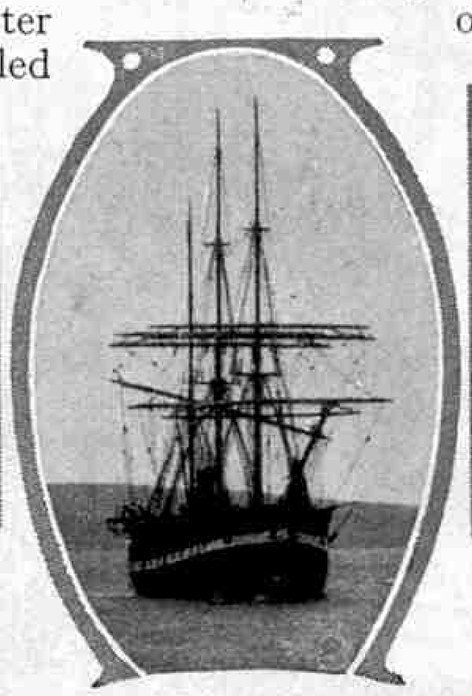
On 19th July the Armada was sighted off the Lizard. By this time there were only about 120 ships left of the 130 that had sailed from Lisbon with some 30,000 men; and of these vessels only about 60 could be considered real warships, the remainder being armed merchantmen. The news of the sighting of the Armada was brought to Lord Howard, who was playing bowls on Plymouth Hoe; and everyone is familiar with the story—which there is no reason to doubt—of how Drake waved the messenger aside, saying that there was plenty of time to finish the game and beat the enemy afterwards. The admirals then put to sea, each eager to be the first to tackle the Spaniards.

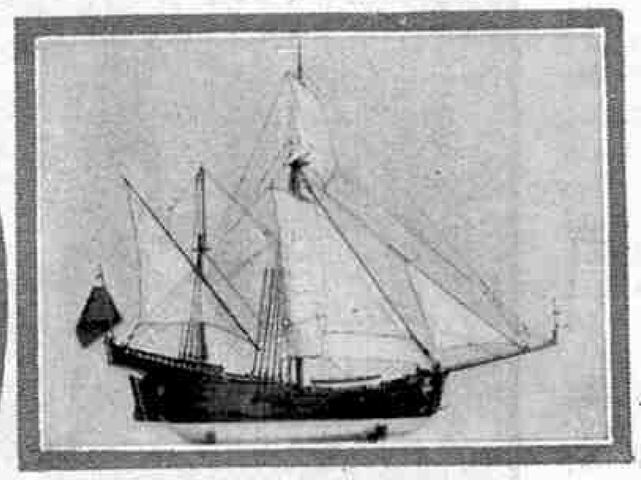
(*Continued on page 748*)

Sea Dogs of the North

Famous Hudson Bay Skippers

IN 1668 a group of enterprising noblemen headed by Prince Rupert organised a venture to finance and undertake a voyage to the Arctic regions to discover the north west passage and to engage in the fur trade with the North American Indians. The "*Nonsuch*," a vessel of about 50 tons, was bought for £290, and after being equipped for her historic voyage she sailed from Gravesend on 3rd June, 1668, laden with cargo and with 42 people on board. These courageous pioneers failed to find the north west passage but they succeeded in establishing the first trading post in the Hudson Bay region. In 1670 the enthusiastic promoters were granted a Royal Charter by Charles II with the title of "The Governor and Company of Adventurers of England Trading into Hudson's Bay," and ever since have been known as the Hudson's Bay Company.





(Left) s.s. "Nascopie" steaming into Chesterfield Inlet. (Centre) s.s. "Erik" anchored in Rigolet Harbour, Labrador coast. (Right) The ketch "Nonsuch."

Succeeding voyages resulted in numerous trading stations being set up in the region of Hudson Bay, and to these the fur trappers brought. and still bring, their stocks of fur to dispose of them to the Company's agents. The fur trappers have told many exciting stories of their adventures in the far North of Canada, but equally thrilling tales of perils boldly faced and often triumphed over can be told of the hardy skippers of the ships which convey food and other supplies to the Company's trading stations. With very few exceptions, and all of them previous to 1726, these ships have throughout each year regularly made the long trips from the sheltered waters of the Thames through the ice-infested Arctic seas to Hudson Bay. In the days before the coming of the steamship and the auxiliary sailing vessel the voyage was especially hazardous, and the Hudson's Bay skippers of those days were veritable "sea dogs" of the North. The sailing ships of the company were sturdy vessels well equipped for the dangerous voyage to Hudson Bay, and many of them came through long periods of service without accident or loss. Some of them had remarkable escapes from disaster when they passed close by, or actually collided with, icebergs.

Captain Bishop.

A famous Hudson Bay skipper of the last century was Captain Henry Bishop, a Londoner and a seaman of the old school. First as Seaman, then as Mate, and finally as Master he sailed to and from Hudson Bay for more than 40 years, and it is said that in all that period he never lost a packet of merchandise. During his 40 years' service this doughty skipper sailed many notable ships. He was in command of the sailing vessel "*Prince Rupert*" from 1865 to 1873, and of the famous "*Lady Head*" from 1873 to 1875 and again during the period 1886–1890. During 1874 he commanded the "*Ocean Nymph*" on the outward voyage to the Bay, and from 1876 to 1885 he was in charge of the sailing ship "*Prince of Wales*," a vessel in which he had served in a lower rank for several years before receiving his first command in 1865.

Though Captain Bishop never met with shipwreck he had many perilous and adventurous cruises. On one occasion when he was in command of the "*Prince Rupert*" an unusually large number of icebergs were encountered in the Atlantic during an outward bound voyage to York. A heavy fog was on the sea and the ship was moving along under reduced sail. Suddenly a great iceberg towering higher than the ship's mast loomed up out of the fog, and the ship passed so close to it as to upset its equilibrium. The great mass, probably millions of tons in weight, fell directly across the wake of the vessel and there was a deafening roar, followed by an upheaval of water that threatened to engulf the ship.

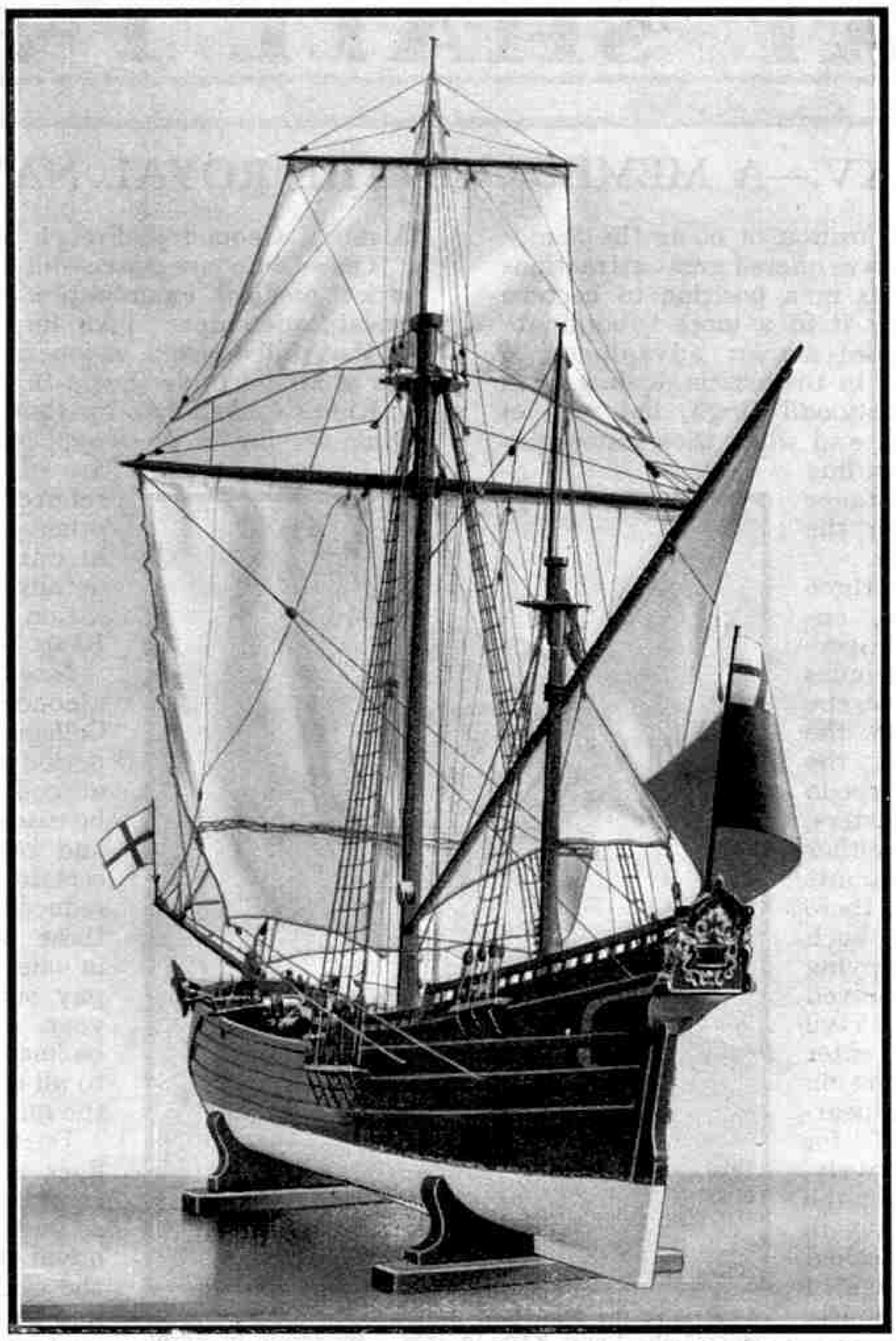
On another occasion, when Captain Bishop was in command of the "*Prince of Wales*" ice was encountered in the Atlantic four degrees east of Resolution Island at the entrance to Hudson Strait. The ship was on the way from London to Moose Factory (Hudson Bay) and began resolutely to punch her way through the ice, but progress was so slow that a whole month was taken up in sailing the 600 miles to Charles Island. During most of this time the ship was beset by the ice and at times the tremendous pressure threatened to crush her to pieces. Eventually she arrived at Moose, a month overdue. having taken 14 weeks and 3 days to complete the journey. The voyage was a test of endurance and entailed long days and nights of sleepless vigil for these hardy men of the sea. The ship was torn and scarred by her gruelling experience but fortunately escaped any vital damage and two weeks later she left Moose on the homeward voyage to London and accomplished the journey in six weeks.

The "*Lady Head*" which Captain Bishop commanded for a short time in the 'seventies was one of the last of the sailing ships employed by the Hudson's Bay Company. This ship was built in 1865 and although smaller than the

"*Prince of Wales*" she was a handsome vessel. In those days the usual time taken to cross the Atlantic was from 11 to 15 days, but in one trip during 1900 the "*Lady Head*," commanded by Captain Ford, made the crossing in the record time of eight days. The ship was off Cape Farewell on the 20th September and passed the Lizard on the 28th of the same month. In recognition of this wonderful achievement Captain Ford was warmly congratulated by the Board of the Hudson's Bay Company, and he was presented with a magnificent silver cup, beautifully engraved. After nearly 40 years' service the "*Lady Head*" stranded on Gasket Shoal on 16th September, 1903, and was abandoned nine days later.

The Hudson's Bay Company had another fine skipper in Captain Gray, who commanded the sailing ship "*Erik*" from 1891 to 1900. One of his most thrilling experiences while in charge of this vessel occurred one night when the ship was moving slowly through a thick fog in the neighbourhood of Resolution Island. A strict lookout for ships and icebergs was being kept but the fog was so dense that when a huge iceberg suddenly appeared right ahead of the ship there was no time for anyone to give warning of approaching danger. The lookout man descended to the deck quicker than he had ever done before, but even as he did so the ship struck the iceberg. There was a violent thud followed by the splintering and crashing of wood as her long bowsprit of pitchpine crumpled up like so much matchwood, and huge masses of ice came thundering down on her forecastle head, smashing up the woodwork. In the meantime the lookout man had sprinted aft and the watch below had come tumbling up on deck and had made for safety. Fortunately all damage to the ship was above the waterline, and by the time that daylight came she was well clear of the iceberg, the side of which was seen to contain a hole as big as a house where the bow of the ship had penetrated it. The captain was probably the coolest and most collected of the ship's crew, and at breakfast that morning all he said in reference to the affair was "Aye, aye, a little ice!"

Captain Gray commanded the sailing vessel "*Labrador*" from 1871 to 1882, and he was given charge of the s.s. "*Pelican*" when the Hudson's Bay Company bought this former man-of-war from the British Admiralty in 1901 for use as a supply ship. He was in command of the ship during each voyage from 1901 to 1908 inclusive, with the exception of that made in 1905. During her trip that year she ran aground near Cartwright and incurred considerable damage, and had to proceed to St. John's, Newfoundland, for repairs before she could continue her voyage northward. In 1905, the "*Discovery*," Captain Scott's ship of Antarctic fame, came into the possession of the company, and Captain Gray was placed in command.



A fine model of the "Nonsuch," the first H.B.C. ship to sail into Hudson Bay (1668). The illustrations to this article are reproduced by permission of the Governor and Committee of the Hudson's Bay Company.

Large sailing ships now belong to a past order of things, but in their day they were unsurpassed in design, construction and sailing qualities. The skippers of the Hudson's Bay Company's sailing ships were, without exception, truly great men, and their crews, mostly English and Shetland sailors, were fine handsome fellows. It was a great sight to see these men going aloft as their ship got under way, and to hear them singing sea shanties as they went about their work. Even in the face of hardships they were always in the best of spirits. The development of the steamship introduced a new order of things, but the same spirit of cheerful courage and fine seamanship characterises the skippers and crews of the Company's steamships. The perils of the Arctic regions have not been greatly lessened by the modern vessel's greater speed and independence of wind, and thrilling adventures are still the lot of the hardy crews who make the long trips to the Company's scattered trading stations. The following true story amply bears this statement out.

On Wednesday, 22nd July, 1925, the steamship "*Bayeskimo*" commanded by Captain Lloyd left Port Burwell, the most northerly point on the Labrador, bound for Fort Chimo, a trading station at Ungava Bay. Next morning two extensive fields of ice were seen in the vicinity of the ship, one in the west and the other in the north. As the hours passed the huge masses of ice slowly drew nearer together, and in spite of every effort of the Captain to steer his ship clear, the ice moved steadily nearer and ultimately closed around her.

The "*Bayeskimo*" was a fine sturdy ship, of which all were justly proud, but no vessel, however well built, could withstand such terrific pressure against her, and by two o'clock in the afternoon she was severely crushed and was leaking badly. It was clear that she was doomed, and finally the Captain gave the order to "abandon ship." Thirteen boats, two of them powerful motor driven craft, were launched as quickly as possible, and ample supplies of food, water, gasoline, deerskins and other necessaries were lowered into them. The passengers and crew were then safely transferred to the boats but before finally abandoning the sinking ship a wireless message was sent to the sister ship "*Nascopie*," giving the position of the wrecked steamer.

The crew and passengers (*Continued on page 770*)

XXXV.—A MEMBER OF THE ROYAL NAVY

THE Royal Navy holds the proud position of being the Senior Service, and a career in it has always offered great attractions to the active boy, whether he is in a position to become a commissioned officer, or must enter it in a more subordinate capacity. Life in the Navy possesses similar advantages to those referred to in our August issue in the article dealing with Army careers. The pay is not exceptionally high, but men of all ranks are fed, clothed and housed, and when they retire may receive a pension, the amount depending on their rank, and are entitled to assistance from special organisations formed for the purpose of looking after their interests.

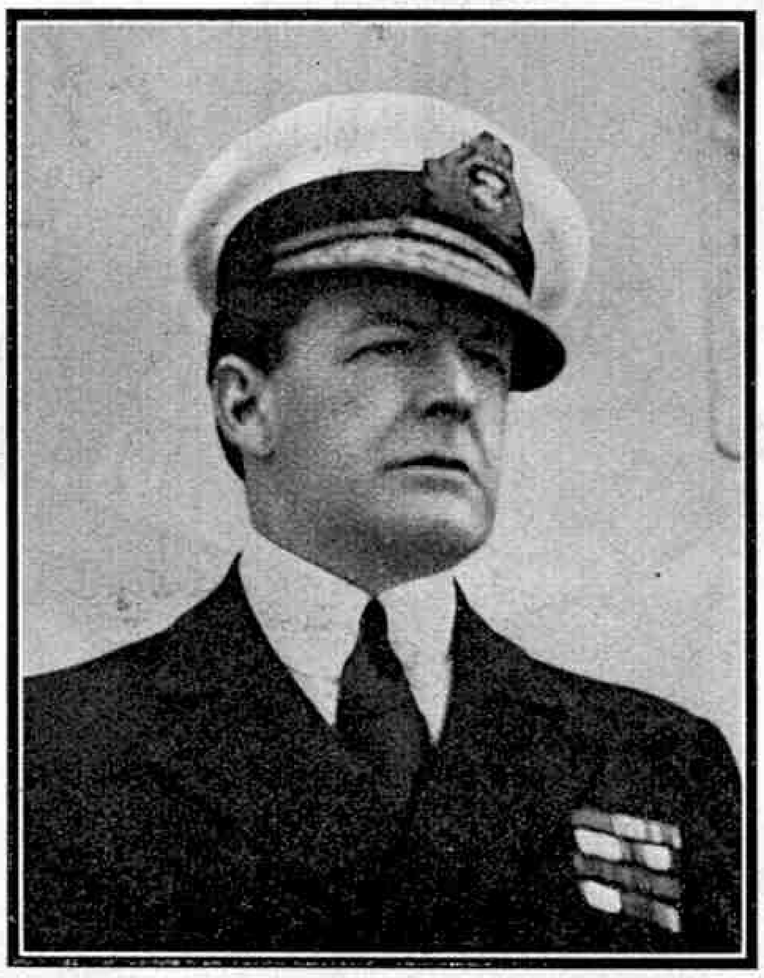
Naval officers usually serve in one of three branches, known as the executive, engineering and paymaster divisions respectively. The first of these branches includes deck or navigation officers; those in the second branch are responsible for the operation and maintenance of all the machinery on board ship, and of torpedo and electrical fittings; while the paymasters, who constitute a smaller branch than either of the other two, look after the accounts and finances of a ship. In addition, there are more highly specialised officers, such as dentists and doctors. Those occupying positions of this kind must have received a thorough professional training in civil life, and the means by which they enter the Navy were explained in the articles on careers in medicine and dentistry that appeared in this series in the issues of the "*M.M.*" for March 1931, and January 1932, respectively.

There are four methods of entering the commissioned ranks of the Royal Navy in the executive branch. The normal method is to become a naval cadet at the age of 13 years and undergo training at Dartmouth. The second also involves becoming a cadet, and is intended for older boys, who are described as "special entry cadets." The third method is to complete a course of training in H.M.S. "*Conway*," or H.M.S. "*Worcester*," or at the Pangbourne Nautical Training College, as explained in the article on careers in the Mercantile Marine that appeared on page 28 of the "*M.M.*" for January, 1931, and then to obtain a scholarship qualifying for a cadetship. Lastly, men from the ranks may work their way up to a commission, but only a limited number can possibly secure promotion in this manner.

Naval cadets are admitted for training at the Royal Naval College at Dartmouth when they are between the ages of 13 years and 5 months and 13 years 9 months. Entry is by means of a qualifying examination after an interview, and application forms may be obtained at any time from the Private Secretary to the First Lord of the Admiralty, The Admiralty, Whitehall, London, S.W.1, but these should not be filled in and returned until the candidate is 12½ years of age. The examinations are held three times a year, in December, March and July. All candidates, except those from the Dominions or Colonies, are interviewed about a month before the date of the qualifying examination, and usually only those who satisfy the committee as to their suitability are allowed to take the examination itself. Papers are set in English, History, Geography, Arithmetic, Algebra, Geometry, French and Latin.

Those who are successful in the qualifying test must pass a strict medical examination before they can be appointed to naval cadetships. An important feature of this examination is that full normal vision is necessary, and no boy whose eyes are at all defective should think of entering Dartmouth as a cadet.

King's Cadetships, for the sons of men who were killed or died while serving in the Royal Navy, Army, or the Royal Air Force, are offered on similar conditions to those referred to in the articles on careers in other branches of the Services published in our issues for July and August. Full details of these may be obtained on application to the Private Secretary to the First Lord of the Admiralty.



Admiral of the Fleet Earl Beatty, O.M., G.C.B., D.S.O., entered the Royal Navy in 1884. He served in Egypt and the Sudan with the naval brigade, and took part in the expedition to China in 1900, on account of the Boxer Rebellion. In 1913 he took command of the Battle Cruiser Squadron, and fought actions in the Heligoland Bight and off the Dogger Bank. The glorious part he and his battle cruisers played in the Battle of Jutland will be known to all readers. From 1916 to the end of the War Earl Beatty was in command of the British High Seas Fleet, and on board his flagship, the "Queen Elizabeth," he received at Scapa Flow on 16th November, 1918, the surrender of the German Grand Fleet.

Naval cadets are required to undergo a course of instruction at the Royal Naval College, Dartmouth, that extends over a period of 11 terms, or 3⅔ years. While at college payment of £150 a year must be made, and in addition the cost of uniform and other incidentals must be met. A certain number of cadets are taken at reduced fees, however, 10 per cent. of these being selected from sons of officers in one of His Majesty's services. These pay sums varying from £40 to £100 per year, and applications for reduction must be made on a special form that is issued to all candidates who are selected to attend the qualifying examination.

Dartmouth College is organised on naval lines and in it the discipline of a ship is combined with the work of a school. It is under the command of a captain and naval staff, and a headmaster superintends the work of a staff of masters. No definite line can be drawn between the educational part of the instruction and the technical training, however, and when the cadet leaves he has acquired a sound knowledge of mathematics, science and English, in addition to training in engineering subjects and in seamanship and navigation. Special attention is paid also to drill, physical training and sports of all kinds, and in their final years cadets spend short periods afloat in the College sloop, and also undergo one trip in a submarine during their course. No pay is given, but pocket money amounting to 1/– a day is allowed, the expense of this being met by parents.

A passing-out examination in the subjects of College work follows the completion of the normal course. First, second and third-class passes are awarded, and the position attained is taken into account in promotion to the rank of sub-lieutenamt. A cadet who obtains a first-class pass has his promotion to this rank accelerated by four months, while one gaining a second-class is given two months' preference.

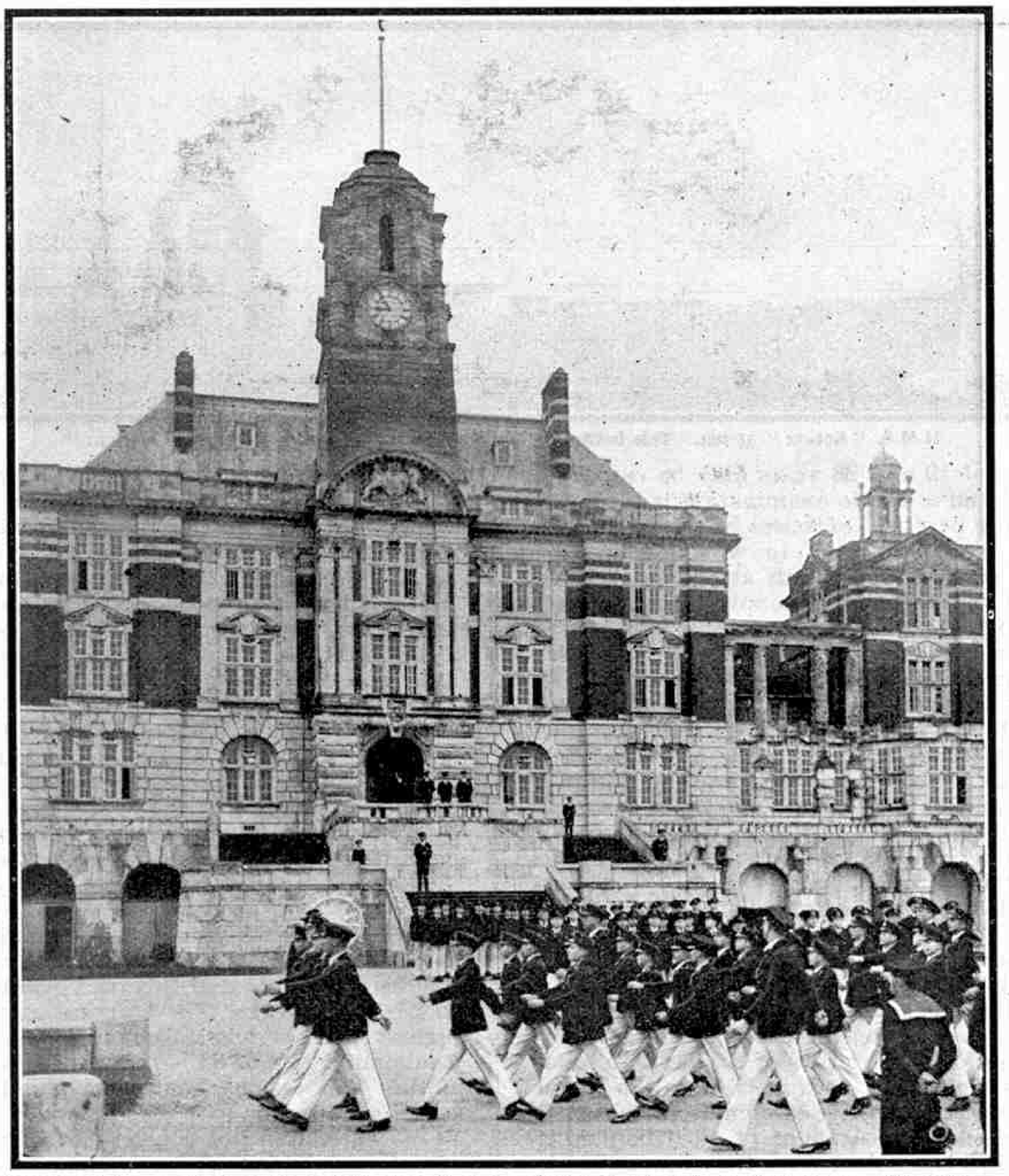
After leaving the College a cadet is normally sent to sea for about eight months before being appointed Midshipman, and during this time he is paid 5/– per day, 1/– of this money being provided by his parents.

During this period instruction of a practical character is given in seamanship, navigation, pilotage, gunnery, torpedo work and engineering. A further examination follows, and the results

of this decide the order of seniority of the cadets when they become Midshipmen. At this stage in his career, a Midshipman decides whether he wishes to be an executive or an engineer officer. Those choosing the second of these alternatives go to Keyham Engineering College for a four years' course.

A Midshipman who proceeds to sea in the executive branch may normally expect to be promoted to acting Sub-Lieutenant after spending about 2 years 4 months as a Midshipman. In this position pay amounting to 7/6 per day is made, and thus the young officer should be able, by exercising a reasonable amount of economy, to become practically independent of his parents. Further promotion follows automatically until the rank of Lieutenant-Commander is reached, but appointments to higher rank are made by selection, those who do not become Commanders or Captains before reaching certain ages usually being retired. Promotion to Rear-Admiral is by seniority, and a Captain may ordinarily expect to attain this rank before he retires, though he may, exceptionally, be retired as a Captain. Seniority decides further progress, except to Admiral-of-the-Fleet, the highest rank of all, and opportunities depend largely on the appointments available.

The retired pay attached to the various grades depends on a basic rate laid down for each rank, to which either additions or deductions are made in respect of years of service in excess or short of the standard period laid down for each rank. Officers of the rank of Lieutenant or above are liable to be placed on half pay or unemployed pay when no appointments are available for them, but it is only exceptionally in the case of officers below the rank of Captain that an officer is placed on half pay or unemployed pay at a rate below that of the full pay rate.



Naval cadets marching off from "divisions" at the Royal Naval College, Dartmouth. The wheel seen in the background formerly belonged to the old Royal Yacht "Osborne."

Those who wish to enter the engineering branch follow the course already outlined for officers in the executive branch until the end of the training at Dartmouth, and the further special instruction they need is given in the Royal Engineering Naval College at Keyham.

The course lasts four years and consists of thorough scientific and technical instruction in various branches of mechanical and electrical engineering. Theoretical and practical work is carried out in the class rooms, laboratories and workshops of the College, and as this is adjacent to the Naval Dockyard at Devonport, there are ample opportunities for following the procedure involved in the building, equipment and maintenance of naval vessels. The training given at the College is recognised by the Institute of Mechanical Engineers, the Institute of Naval Architects and other competent authorities.

On completion of the engineering course cadets are required to take a passing-out examination, on the result of which they are eligible to receive accelerated promotion to the rank of Lieutenant, when they will be sent to various ships in the Navy.

The second method of entering the Navy as an officer is to become a special entry cadet. A boy who wishes to follow this course remains at school until he attains the age of 17½ and then takes an examination conducted by the Civil Service Commissioners. Normally this is held twice a year, in June and November, and candidates must be between 17½ and 18½ years of age. Application forms may be obtained from The Secretary, Civil Service Commissioner, Burlington Gardens, London, W.1, but before applicants may be admitted to the examination they must produce either School Certificate A or a recognised certificate of equivalent or higher standing. All candidates are interviewed by a special committee and must pass a medical examination.

Those who are successful in this examination are entered as Naval cadets and are required to attend a course of training for 12 months on board H.M.S. *"Erebus"* at Devonport. This time is divided into three terms. Uniform will cost about £80, and other expenses amount to about £70. This brings the total cost to approximately £200, which is of course appreciably less than the cost of obtaining a commission through Dartmouth.

Cadets who complete the course and are successful in the passing-out examination are rated Midshipmen and, as in the case of Dartmouth cadets, may elect to proceed to sea as Midshipmen in the Executive Branch or to go to the Royal Naval Engineering College at Keyham, Devonport, in order to qualify for the engineering branch.

Boys who wish to become paymaster cadets must qualify as special entry cadets and undergo the usual training during the first year. They are then rated Paymaster Midshipmen, subject to obtaining a certificate of competency, and are posted to vessels in the Fleet. The medical examination for paymaster cadets is not so strict as for those who wish to enter other branches of the Navy, but all candidates must be able to swim at least 50 yards.

We have already pointed out that the third method of beginning a career in the Navy is open to boys who have undergone a course of training in preparation for life in the Merchant Service. A certain number of boys from the training ships *"Conway"* and *"Worcester,"* or from the Nautical Training College, Pangbourne, are awarded scholarships in H.M.S. *"Erebus"* each year. These boys pursue the same course as special entry cadets.

Turning now to the rank and file, a career in the Navy is very attractive to boys and young men of good character and physique, for they live in healthy surroundings, and if their conduct has been satisfactory they retire from the service with good pensions. In addition, many of them learn a good trade while in the Navy, and special classes are arranged in order to give training likely to be useful in civil life to men about to take their discharge.

Full details of the requirements for entry into the various branches of the Navy and of the conditions of service are contained in a booklet entitled *"How to Join the Royal Navy."* Copies of this may be obtained free from Post Offices and recruiting depots, or direct from the Secretary of the Admiralty, Whitehall, London, S.W.1.

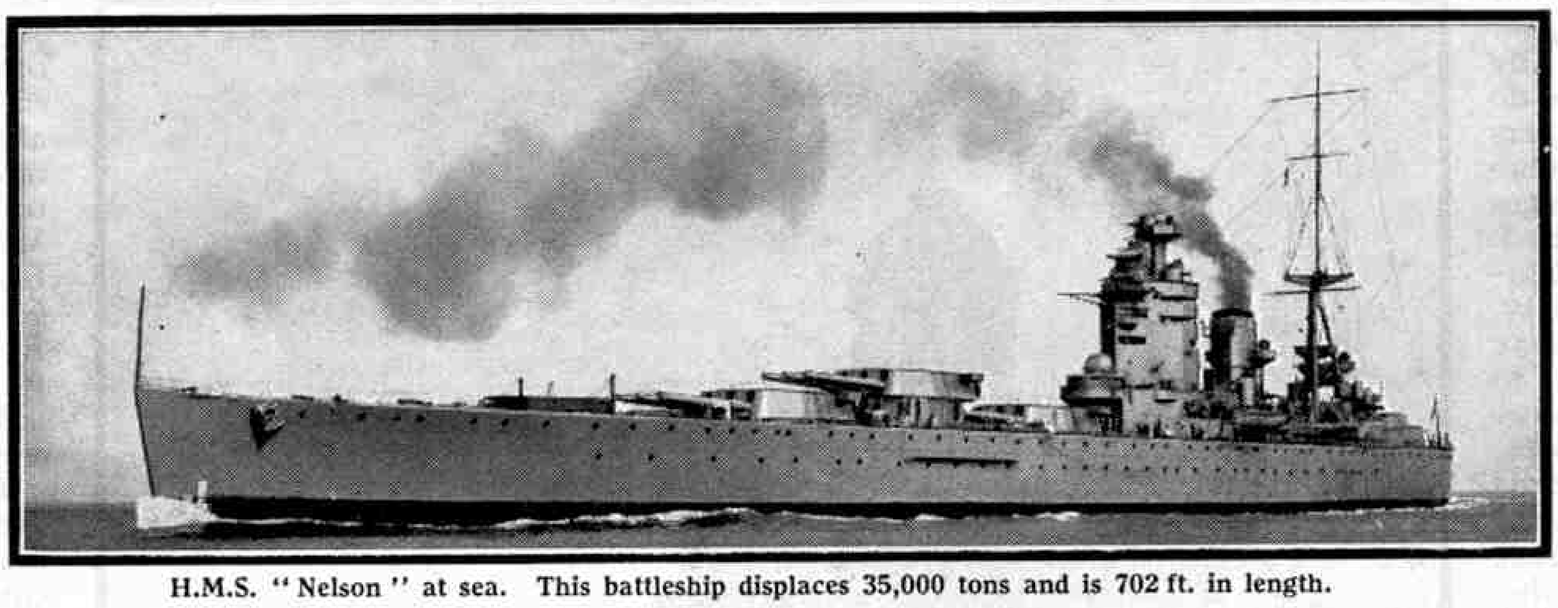
Boy recruits for the Navy are accepted when between the ages of 15 years and 16½ years, and are required to serve for a period of 12 years after reaching the age of 18. They are entered as Seaman Class Boys for training as seamen, and those who show the necessary aptitude are given special instruction to fit them for early advancement.

Other openings for boys are to be found in special branches of Naval work. For instance, many fitters, turners, blacksmiths, boilermakers, coppersmiths and competent workmen in other trades are required, and a limited number of candidates for

training in these trades are accepted twice yearly on the results of special examinations. Candidates must be between 15 and 16 years of age. If successful they become engine-room artificer apprentices, and on completion of their training are rated as engine-room artificers. Every year one or two apprentices are promoted to Midshipmen and are sent to Keyham, where they are trained to become officers in the Engineering Branch of the Navy.

A limited number of similar openings for training as Electrical Artificers, Ordnance Artificers and Shipwright Apprentices, also are available. These are secured by means of competitive examination, and the conditions are similar to those obtaining for engine-room artificer apprentices.

The Signal and Wireless Telegraph Branches offer openings for Seaman Class Boys, a number of whom are selected for the special training necessary. In addition, there are many positions open to young men of various ages who have special trade qualifications. For instance blacksmiths, joiners, painters and plumbers between the ages of 19 and 28 years may be recruited. Good character is essential and a simple examination is held as a test of ability, this including practical exercises in the trade concerned. Other positions available, entry to which is secured on similar terms, include posts as sick berth attendants, cooks, stewards and members of the writer and supply branches who keep accounts and deal with stores.



H.M.S. "Nelson" at sea. This battleship displaces 35,000 tons and is 702 ft. in length.

The pay in the non-commissioned ranks of the Navy varies according to the work carried out. A Seaman Class Boy of 15 years of age receives about 5/3 per week, and an ordinary seaman of 18 years of age is paid 14/– a week, increasing to 21/– on promotion to able-seaman, and later to 25/–, while a Chief Petty Officer receives 52/6 or more. These rates of pay are in addition to free food and clothing, and do not include allowance for good conduct or for special qualifications. Allowances range from 1/9 to 10/6 and are granted for proficiency in gunnery and torpedo work, and for physical training qualifications.

Although the Royal Marines are trained as soldiers, they form a portion of the Naval forces of the country, as is indicated in their motto, "*Per mare, per terram*," which means "By Sea and Land." The Corps is attractive to boys and young men who have a liking for soldiering combined with a life at sea. It includes a large proportion of warrant and non-commissioned officers, and thus offers good opportunities of promotion to members of the rank and file.

In order to obtain an appointment as an officer in the Royal Marines, it is necessary to pass a competitive examination conducted by the Civil Service Commissioners. A fee of £4 must be paid if this is taken in London, and £5 is required when the examination is taken at any other centre, while a small local fee is sometimes payable. Candidates for the examination are also required to attend an interview and undergo oral and practical tests in London. Before sitting for the examination, all candidates must have secured a School Certificate A or have passed some exempting examination.

Candidates who are successful in the examination are appointed Probationary Second Lieutenants and undergo a course of training lasting about 2½ years. This is not carried on at one college, as in the case of naval cadets, Probationary Second Lieutenants travelling to various centres for courses in infantry drill and military discipline and procedure, theoretical and practical military practice, preliminary naval gunnery, electricity, mining, seamanship and navigation. On satisfactorily passing these courses, and provided that about three years have elapsed since the date of entry, officers are promoted Probationary Lieutenants and are then embarked as opportunity offers as Subalterns of Royal Marine detachments afloat, for practical instruction and detachment duties. On completing six months' service afloat, the officers are confirmed in the rank of Lieutenant.

Probationary Second Lieutenants are paid 6/8 a day, while Lieutenants receive 8/10 a day on entry. This is increased from time to time by promotion and a Captain receives 26/8 a day on promotion, correspondingly higher pay being given to those attaining higher rank. Officers are retired compulsorily at specified ages, but are all granted retired pay.

In order to join the ranks of the Royal Marines it is necessary to be between the ages of 17 and 23 and to conform to certain standards of height and chest measurement. Enlistment is for 12 years from the age of 18, or date of entry if older, with the prospect of joining the Royal Fleet Reserve on discharge. On completing the 12 years' service, men of good character may be permitted to re-engage for a further term of nine years.

The weekly rates of pay vary greatly, the lowest being that of a boy bugler, who receives 5/3 a week on enlistment. A Marine is given 14/– a week on enlistment, and after one year this is increased to 19/3. On completing training for embarkation the Marine's pay becomes 21/– and this rises eventually first to 23/4 and then to 25/8 per week. The corporal's pay starts at 32/1 while the highest non-commissioned rank, quartermaster-sergeant, carries a minimum pay of 63/– per week. All pay is in addition to free clothes and rations, and men who have some knowledge of a trade may easily earn extra money. Further information will be obtained from the booklet "*How to Join the Royal Navy*," previously mentioned, or by writing to the Editor of the "*M.M.*"

Famous British Admirals—(*Con. from page 743*)

Throughout the following day the Armada moved slowly up Channel towards Plymouth, while the English ships were coming out from the Sound against a stiff breeze and working to windward. On the 21st the English swept down with the wind to the attack, firing at a range at which the Spaniards could make no effective reply. Each ship after delivering her broadside swung round to take position astern while her guns were reloaded. Howard did not press his attack on this first day, but the Spanish fleet was thrown into confusion, so that collisions were frequent. As a result the "*Rosarie*" was captured, and the "*San Salvador*" was so badly damaged by an explosion of gunpowder that, although she escaped at the time, she was afterwards abandoned and captured.

The two fleets moved farther up Channel. On the 25th there was a sharp fight off the Isle of Wight, and subsequently, the wind having changed in their favour, the Spanish ships reached Calais and anchored in the Roads on the 27th. The English anchored well to windward, and on the following night Howard sent a number of hastily improvised fire ships among them. To save themselves the Spanish ships were obliged to cut their cables and make for the open sea. On the next day the final great encounter took place, known as the battle of Gravelines. It lasted the whole day, and extinguished all the remaining hopes of the Armada. The English again pursued their policy of long-range firing, resisting all attempts of the enemy to come to close quarters. They poured a murderous succession of broadsides into the Spanish ships, and by night few of these were in a condition to continue the fight.

On the following day Medina-Sidonia held a council of his commanders, and finally decided that the only hope for the fleet was to take advantage of the wind and escape by way of the North Sea and round the north of Scotland. Thus commenced a terrible voyage, and ship after ship was driven ashore and lost on the coasts of Scotland or Ireland.

In 1595 Drake obtained command of an expedition organised to raid Panama and the West Indies, and he set out with a fleet of 27 ships carrying 2,500 men. In contrast to the good luck that attended all his early expeditions, this voyage was unfortunate almost from the start. Drake found that he could no longer take the Spanish colonies by surprise; and although he captured several towns and cities it was to find that all treasure had been removed. To add to the misfortunes of the expedition sickness developed among the crews. Drake who hitherto had escaped now fell a victim to the fever, and after a few days of illness he died on 28th January, 1596, while his ships were anchored off Portobello, the scene of one of his earliest exploits against the Spaniards. His body was enclosed in a leaden coffin and was committed to the Atlantic Ocean.

How Wireless Waves Curve Round the Earth

The Heaviside Layer

ONE of the minor mysteries of wireless is that radiations sent out from a powerful station are readily received on the other side of the world, in spite of the fact that the Earth is round. When wireless waves were first discovered they were regarded, quite correctly, as being similar to light waves. Light does bend round corners, but only to a very limited extent, and generally speaking it may be regarded as travelling in straight lines. Wireless waves, on the other hand, appear to follow the curved surface of the Earth without difficulty. This was unexpected by many early experimenters, and it was prophesied that Marconi's efforts to use the waves for trans-Atlantic telegraphy would fail because the waves would radiate outward in straight lines like the rays of light from a lighthouse, instead of bending round the surface of the Earth to reach the receiving station. It was even stated definitely in certain quarters that good results could only be obtained if the stations in communication were within sight of each other, and it was in efforts to overcome the supposed difficulty created by the curvature of the Earth's surface that the familiar enormous aerials were first developed.

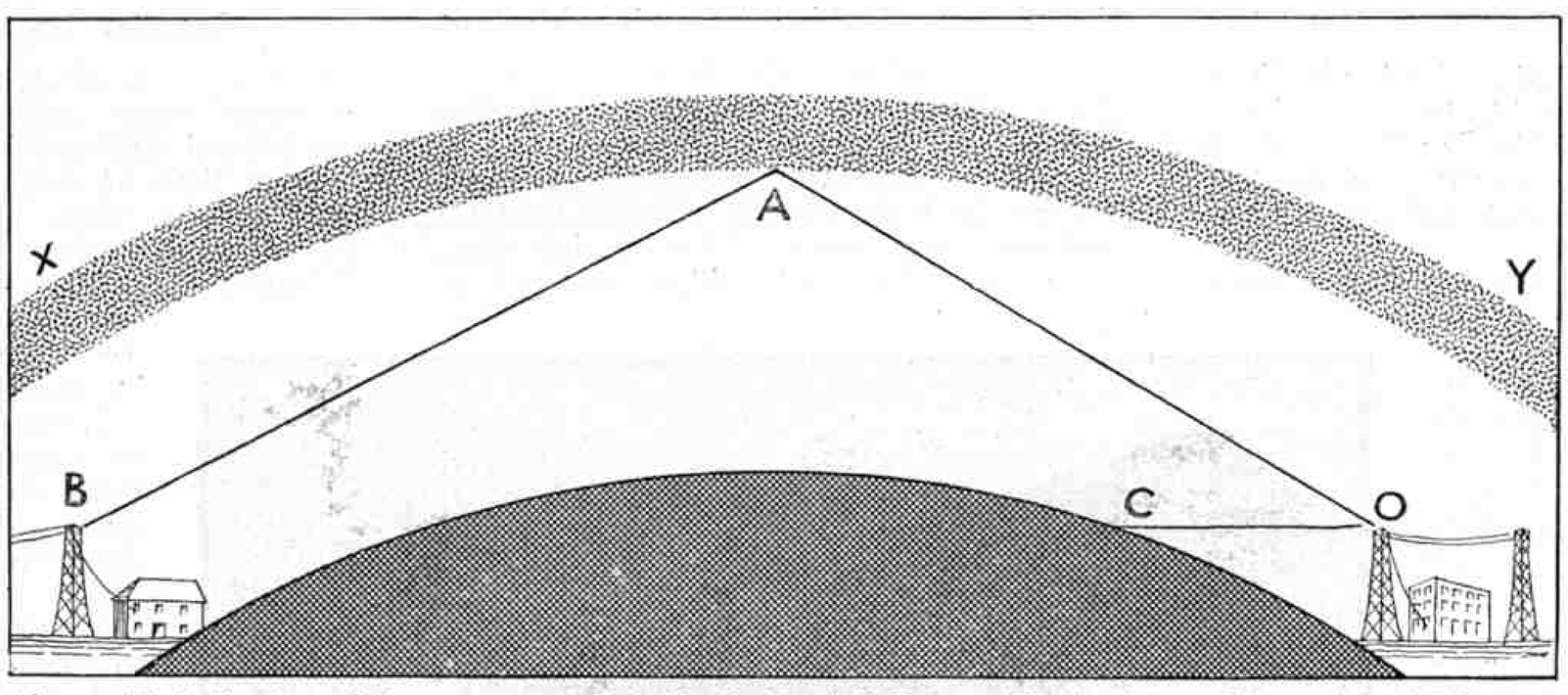


Diagram illustrating how wireless waves are reflected by the Heaviside Layer. The direct wave OC cannot reach B because of the curvature of the earth, but the sky wave OA is reflected downward to B.

The explanation that is now generally accepted of this peculiar behaviour of wireless waves is of special interest because it has brought to the notice of practically every user of wireless apparatus in the world the name of a pioneer whose work previously had remained in obscurity. This was Oliver Heaviside, the British scientist who suggested the existence in the atmosphere of what is now known as the Heaviside layer. This is a screen of electrified particles at a height ranging from 60 to 100 miles, which reflects downward the wireless waves that radiate outward from the Earth.

Heaviside was born in London on 13th May, 1850. His father was an engraver who won considerable repute as a book illustrator, but it is interesting to note that he came of a family with scientific associations, for Sir Charles Wheatstone, a famous pioneer of telegraphy, was his uncle. Heaviside's interests as a young man were similar to those of Wheatstone, and he found employment with the Great Northern Telegraph Company at Newcastle-on-Tyne. Unfortunately he suffered from deafness, and eventually this became so serious that at the early age of 24 he was compelled to retire from active work. He went to live at Torquay, where he continued to work at various electrical problems connected with telegraphy and telephony.

Oliver Heaviside (1850-1925).

It is impossible to give here a full account of the many important contributions that Heaviside made to electrical science, but it is no exaggeration to say that much of the efficiency of modern telegraph and telephone services is due to him. Many of the devices that enable several messages to be sent over one wire have been greatly improved by the adoption of his ideas, but perhaps his most interesting work was that which has enabled us to telephone with ease over long distances. He was the first to realise the importance of inductance in telephony, but his proposal to include loading coils in submarine cables in order to increase their self-inductance was ignored. Professor Pupin, an American scientist, independently made use of such coils with excellent results, and the practice is now universal.

Heaviside was not content with solving problems involved in ordinary telegraphy and telephony, for his work led him to deal with wireless, which was slowly being developed by Lodge, Marconi and others. It was then that he developed his theory of the Heaviside layer, the mysterious screen of electrified particles surrounding the Earth. Wireless waves cannot penetrate such a screen, and are in fact reflected by it much as light waves are reflected from the surface of a mirror. Waves travelling in a straight line that threatens to take them well away from the Earth are therefore intercepted by the layer and turned backward, to descend upon the Earth once more in positions where they can affect wireless receiving apparatus.

The existence of such a layer as that suggested by Heaviside affords the best explanation that so far has been produced for the fact that wireless waves are not lost in outer space, but circle the Earth in such a manner that they can be detected after travelling completely round it. The origin of the electrified particles of which it is composed is not known with certainty. A possible agent in their production is sunlight, which gives rise in our atmosphere to what are called "ions," that is, tiny, electrically-charged particles formed from the gases of which the atmosphere is composed. Sunlight at heights of 60 to 100 miles may be more effective in this respect, and this may account for the appearance of electrified particles in the position that the Heaviside layer is supposed to occupy, and in sufficient numbers to form a complete reflector.

An interesting alternative suggestion is that the ions of the layer come directly from the Sun, the centre of which is at so high a temperature that a proportion of the atoms contained in it are broken up, electrons or negatively-charged particles having been driven out of them. Many of these electrons are projected from the Sun with immense speed, and escape into outer space. Some of these may be caught up in the atmosphere of the Earth, and a proportion of them remaining suspended in it would form the reflecting layer.

Throughout his life in retirement in Devonshire, Heaviside continued to work at abstruse problems in electricity, and it is pleasing to know that his work eventually received recognition from the scientific world. He was elected a Fellow of the Royal Society in 1891, and in 1922 was awarded the Faraday Medal of the Institution of Electrical Engineers, being the first to be honoured in this manner. He died at Torquay on 4th February, 1925.

Russian Air Liner to Carry 36 Passengers

A giant new multi-engined air liner known as the A.N.T.14, has been built in Moscow. The machine is a five-engined high-wing monoplane to carry 36 passengers and is similar in external appearance to the Junkers G.38.

The wing of the machine has a span of 132 ft. 5 in. and is in three sections, the middle section being bolted to the top of the fuselage. The two outer sections taper in plan and thickness and are connected to the middle section at a slight dihedral angle. The whole of the wing is covered with corrugated duralumin.

The fuselage of the aeroplane is 86 ft. 11 in. in overall length and is almost rectangular in cross section. The two upper longerons are hollow metal tubes, but those at the bottom are metal sections, and are connected by means of a number of transverse frames and diagonals. The tail unit is of normal monoplane type and is braced to the fuselage and the fin by means of wires. The tail plane may be adjusted while the aeroplane is in flight. The aeroplane is provided with a split axle undercarriage, and the shock absorbers are carried on legs that run up into the wing.

The A.N.T.14 is equipped with five 480 h.p. "Jupiter IX" air-cooled radial engines. One of these is carried in the nose of the fuselage and the remaining four are mounted in nacelles carried in the leading edge of the wing. They give the machine a maximum speed at ground level of between 130 and 136 m.p.h., and the surprisingly low landing speed of 46.5 m.p.h. is claimed for it. The service ceiling is 4,000 m. or 13,120 ft. The machine weighs 23,450 lb. when empty and 38,150 lb. when fully loaded.

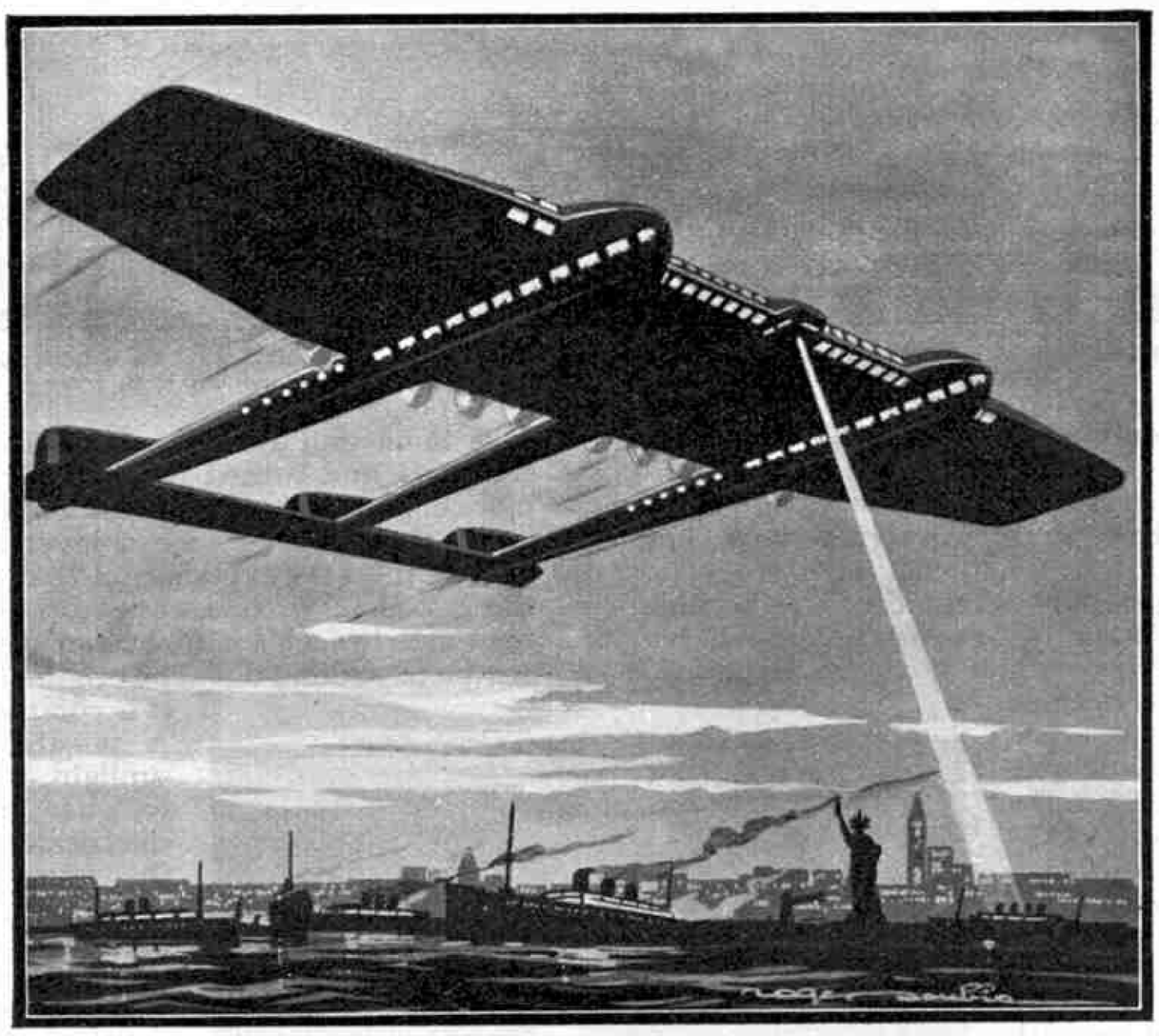
Woman's Altitude Record

A French airwoman, Mlle. Haryse Hilz, recently broke the world's altitude record for woman pilots by attaining a height of more than 10,000 metres, or 6.2 miles, in an aeroplane. The previous record was about 5½ miles, and was held by an American pilot, Miss Ruth Nichols, who flew a Lockheed "Vega."

New Fokker Machine for Dutch Air Line

A new Fokker aeroplane, known as the F.XVIII, has been adopted by the K.L.M., or Royal Dutch Air-lines, five machines of this type having been ordered for use on their service between Holland and the East Indies. It is a high wing monoplane of normal Fokker construction and is provided with three 440 h.p. Pratt and Whitney "Wasp" engines, which give it a maximum speed of 152 m.p.h., and cruising and landing speeds of 126 and 70 m.p.h. respectively. The machine is capable of carrying 12 passengers on short flights. When employed on the normal services of K.L.M. it will be provided with seats for only four passengers, however, and will then be able to accommodate a comparatively large amount of luggage and freight and will carry sufficient petrol to enable it to cruise for 930 miles without refuelling.

The F.XVIII weighs 9,587 lb. when empty, and when fully loaded has a weight of 16,640 lb. It can cruise comfortably with one engine out of action, when it has an absolute ceiling of 4,920 ft.



An artist's impression of a trans-Atlantic aeroplane of the future. It would be necessary for such machines to be fitted with powerful searchlights in order to carry out regular night flying.

Speeding Up Canadian Mail

During experimental air mail flights recently made in Canada, mails were exchanged between Ottawa and London in less than 4½ days, and in some cases the flights were several hours ahead of scheduled time. The C.P.R. liner "*Empress of Britain*" was the vessel concerned in the trials, which were carried on with both incoming and outgoing mail.

Letters from Great Britain to Canada were transferred from the liner to a mine-sweeper of the Royal Canadian Navy in Red Bay, in the Strait of Belle Isle. In this vessel they were carried to Bradore Bay, Quebec, and from this point were taken by seaplane and land-plane to Montreal, a distance of about 910 miles. Mails for Ottawa, and also for New York and other American points to the south, were then forwarded by air, while those for points west of Ottawa were sent on by train. For outgoing mails this procedure was reversed, the "*Empress of Britain*" being overtaken in the Strait of Belle Isle.

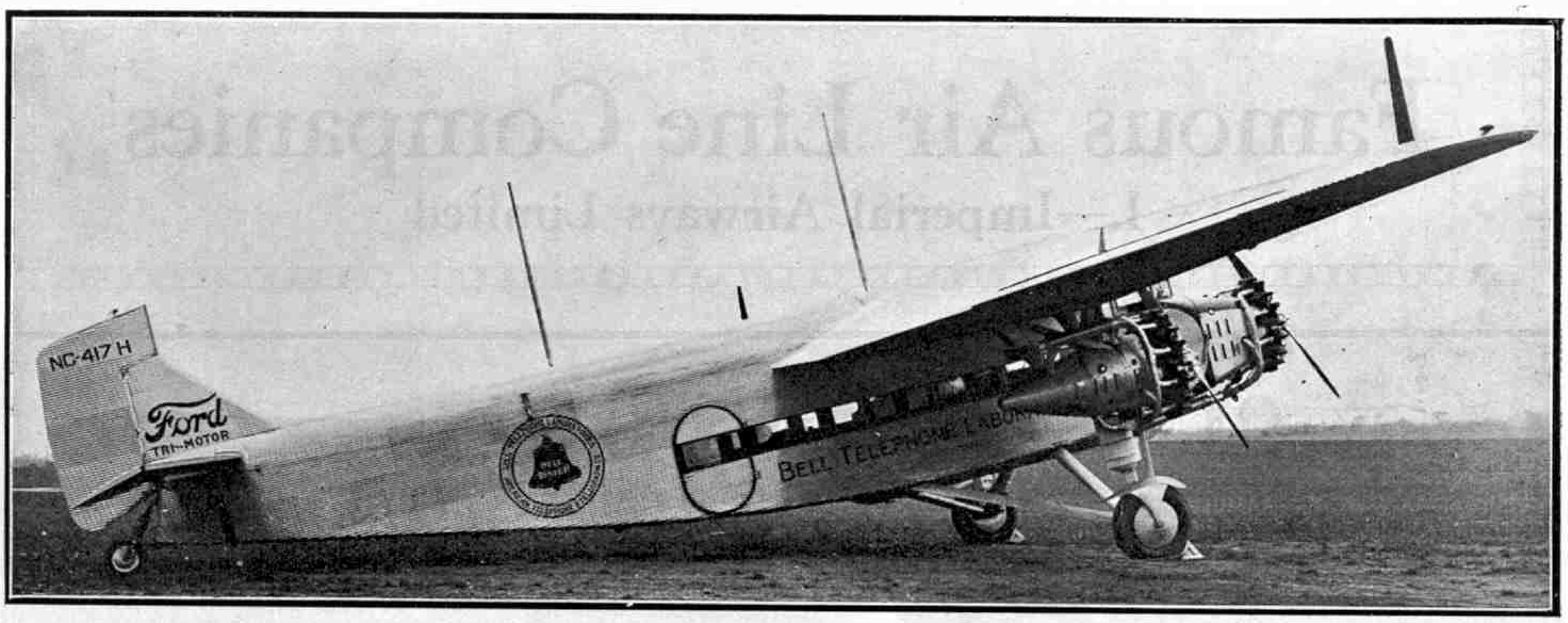
An "Autogiro" with a 50 h.p. Motor

A new and revolutionary type of Autogiro is now being constructed. The machine will be a single-seater and is to be fitted with a small two-cylinder engine developing about 50 h.p. In flight, it will be controlled by tilting the rotor head, and this will make it possible for the lower stabilising wing at present fitted on "Autogiros" to be dispensed with. The rotor of the new machine may be folded, and as it will be only about 15 ft. in overall length, it may be accommodated in the space occupied by a motor car.

Further details of this interesting machine will be published when they are available.

* * * *

A new international record for speed over a distance of 2,000 km. (1,240 miles), has been set up by a French airman, M. Marcel Haegelen, who flew a Hanriot 41 monoplane over this distance at an average speed of 263.9 km. p.h., or 163.88 m.p.h.



A Mobile Mooring Mast for Airships

A huge airship hangar is now being constructed at Sunnyville, California, for the accommodation of United States Navy airships. The hangar is of similar shape to the one at Akron, Ohio, described on page 600 of our issue for August, 1930. It is 1,200 ft. in overall length and 300 ft. in width, and is provided with semi-circular rolling doors, each of which weighs 569 tons and moves on five 9-wheeled trucks.

The first mobile telescopic mooring mast ever constructed for aircraft will be used at Sunnyville. This will be carried on four trucks, about 64 ft. apart, arranged to travel along a special track. When in its lowest position the top of the steel mast will be 80 ft. above the level of the track, and it may be raised to any height up to 160 ft. in order to receive the nose of an approaching airship in its mooring cup. Mooring operations will be controlled either from a "crow's nest" or from a special operator's cabin below.

The mast will have a total weight of about 223 tons. The necessary power for its operation will be derived from two 125 k.w. electric generators driven by a petrol engine developing 565 h.p. These will supply current to four propulsion motors, each of 52 h.p., by means of which the trucks may be driven at a maximum speed of two miles per hour. A 100 h.p. motor is being installed for the purpose of raising and lowering the telescopic steel mast, and the mooring-line winch will be operated by a 130 h.p. motor. Efficient brakes are to be provided, and those fitted to the hoisting mechanism and the mooring winch will be electrical.

New Imperial Airways Service

A new desert air service between Baghdad and Galilee was inaugurated by Imperial Airways last month. The service, which is operated by an Avro Ten air liner, saves travellers the discomfort of a car journey of two days across the desert. The west-bound flight from Baghdad to Galilee is scheduled to occupy 5¼ hours, while the east-bound flight from Ramleh to Baghdad takes 7¾ hours.

New Napier Aero Engine

D. Napier & Sons Ltd., the constructors of the world-famous "Lion" engine, have now produced a new six-cylinder aero engine. The engine is known as type E.97 and is of the air-cooled type. The mounting is extremely clean and the engine has a remarkably low frontal area. It is suitable for use in fast single-engined machines seating three or four people, or for large multi-engined machines.

The upper illustration shows a triple-engined Ford passenger monoplane constructed entirely of metal. Below is a pilot dressed for high altitude work, during which intense cold is experienced.

One of the most unusual features of the engine is the lubrication system, the oil being transferred from one end of the engine to the other through a hollow camshaft. A special hand starting gear is provided.

The cylinders of the E.97 have a bore and stroke of 4½ in. and 5¼ in. respectively, while the compression ratio is 5.3 to 1. When dry the engine weighs 410 lb. It measures 4 ft. 10½ in. in overall length, and is 2 ft. 2 in. in width and 2 ft. 7½ in. in height. It is rated at 150 h.p. at 2,000 r.p.m. and the maximum power developed is 170 b.h.p. at 2,300 r.p.m.

German Airman's Third Atlantic Flight

Herr Wolfgang von Gronau, the well-known German airman, has made a third flight from Europe to America by way of Iceland and Greenland. His previous flights over this route were made in 1930 and 1931, and all were carried out in "Wal" flying boats, the machine employed this year being named the "*Greenland Whale*."

On his most recent flight von Gronau left List, on the Island of Sylt, early on 22nd July, and as the calm conditions then prevailing made it difficult to take off, a Dornier "Super Wal" was taxied ahead of him in order to allow him to take advantage of its slipstream and of the waves it set up. The 1,120 miles between List and Seydisfiord, on the east coast of Iceland, were covered at an average speed of 112 m.p.h. The flight was continued next day and at 10.45 G.M.T. on 26th July, the "*Greenland Whale*" reached Cartwright, on the coast of Labrador. Great difficulty was experienced in alighting safely, owing to a dense fog that prevailed at the time, and von Gronau flew over Cartwright for 2¾ hours while waiting for the fog to clear. Eventually he made a safe landing under wireless guidance. The actual flying time from Iceland to Cartwright was 28 hours and von Gronau afterwards flew to Chicago by way of Montreal.

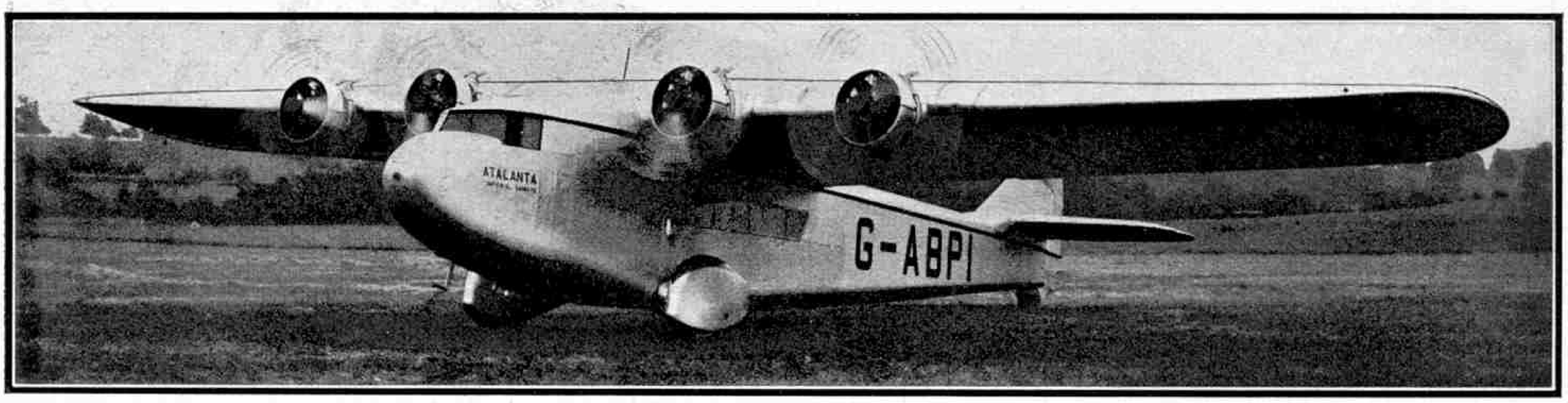
Small German Airship

An interesting semi-rigid airship, known as the Parseval-Naatz P.N. 30, recently has been produced in Germany. This is 151 ft. in length and has a diameter of 35 ft. 6 in., a height of 52 ft. 6 in., and a capacity of 91,830 cu. ft. It possesses accommodation for five passengers and is equipped with a Siemen Sh.14 seven-cylinder engine developing 115 h.p. This gives the airship a speed of 49.75 m.p.h., and a useful lift of more than 2,200 lb. The fuel carried gives a range of 620 miles.

The pressure of the gas inside the envelope is kept constant automatically and this vessel is claimed to be the smallest on which this arrangement is made.

Famous Air Line Companies

I.—Imperial Airways Limited



IMPERIAL Airways Ltd. was formed in 1924 by the union of the four British air lines then in existence. The new organisation provided services to six European countries, the total mileage of the routes covered being 1,760 miles. As the speed and convenience of air travel became more greatly appreciated the services were extended and to-day, eight years after the formation of the company, no fewer than 22 countries may be reached from Great Britain by means of its fleet of aeroplanes. There are daily services to the Continent over routes with a total length of more than 1,000 miles, while the Empire airways to India and Africa, over which weekly services are operated, have added 13,000 miles to the total distance covered, bringing the length of the air routes operated by the company to 14,000 miles. In addition, Imperial Airways machines are often called upon for what is known as special charter work, to distinguish it from the operation of timed services. Business men who wish to visit overseas countries, invalids who are unable to travel by train, and people who are in need of speedy means of travel in emergencies are carried on flights of this type.

The best known of the European services of Imperial Airways is that between London and Paris. Actually flights on this service are made from the aerodrome at Croydon to that at Le Bourget, passengers travelling between these air ports and the centres of the respective capitals by road. Three return flights are made daily on this service, except on Sundays, when there are only two; and the journey is made in luxurious air liners in which meals are provided. Another important service operated by the company is that between London, Brussels and Cologne. Flights on this route are made twice daily, with one on Sundays, and connections may be made by this service at Cologne with the network of German air lines that makes it possible for any German city or town of importance to be reached in a comparatively short time. In addition, services are maintained between London and Zurich by way of Paris and Basle.

IMPERIAL AIRWAYS FLEET

Identification Letters	Names	Type	Routes
G–AAGX	Hannibal	Handley Page "Hannibal"	Cairo to Karachi Section of Indian Route.
G–AAUE	Hadrian		
G–AAUD	Hanno		
G–AAUC	Horsa		
G–AAXC	Heracles	Handley Page "Heracles"	London to Paris.
G–AAXD	Horatius		
G–AAXE	Hengist		
G–AAXF	Helena		
G–ABFA	Scipio	Short "Kent"	Mediterranean Section of Indian and African Routes.
G–ABFB	Sylvanus		
G–ABFC	Satyrus		
G–EBLF	City of Glasgow	Armstrong Whitworth "Argosy"	London to Paris, and Cairo to Khartoum section of African route.
G–EBOZ	City of Arundel		
G–AACI	City of Liverpool		
G–AACJ	City of Manchester		
G–AAEJ	City of Coventry.		
G–EBMM	City of Melbourne	Handley Page W.10	Special hire work.
G–EBMR	City of Pretoria		
G–EBMX	City of Delhi	De Havilland "Hercules"	African Route.
G–EBMY	City of Baghdad		
G–AAJH	City of Basra		
G–AARY	City of Karachi		
G–ABCP	City of Jodhpur		
G–ABMT	Not yet named		
G–EBVG	City of Alexandria	Short "Calcutta"	Mediterranean and Khartoum-Kisumu section of African Route.
G–EBVH	City of Stonehaven		
G–AASJ	City of Khartoum		
G–AATZ	City of Swanage		
G–AASP	Achilles	Avro X	London-Brussels-Cologne.
G–ABLU	Apollo		
G–AAGW	Not yet named	Westland "Wessex"	Special hire work.
G–EBBI	Prince Henry	Handley Page W.8b	Special hire work.

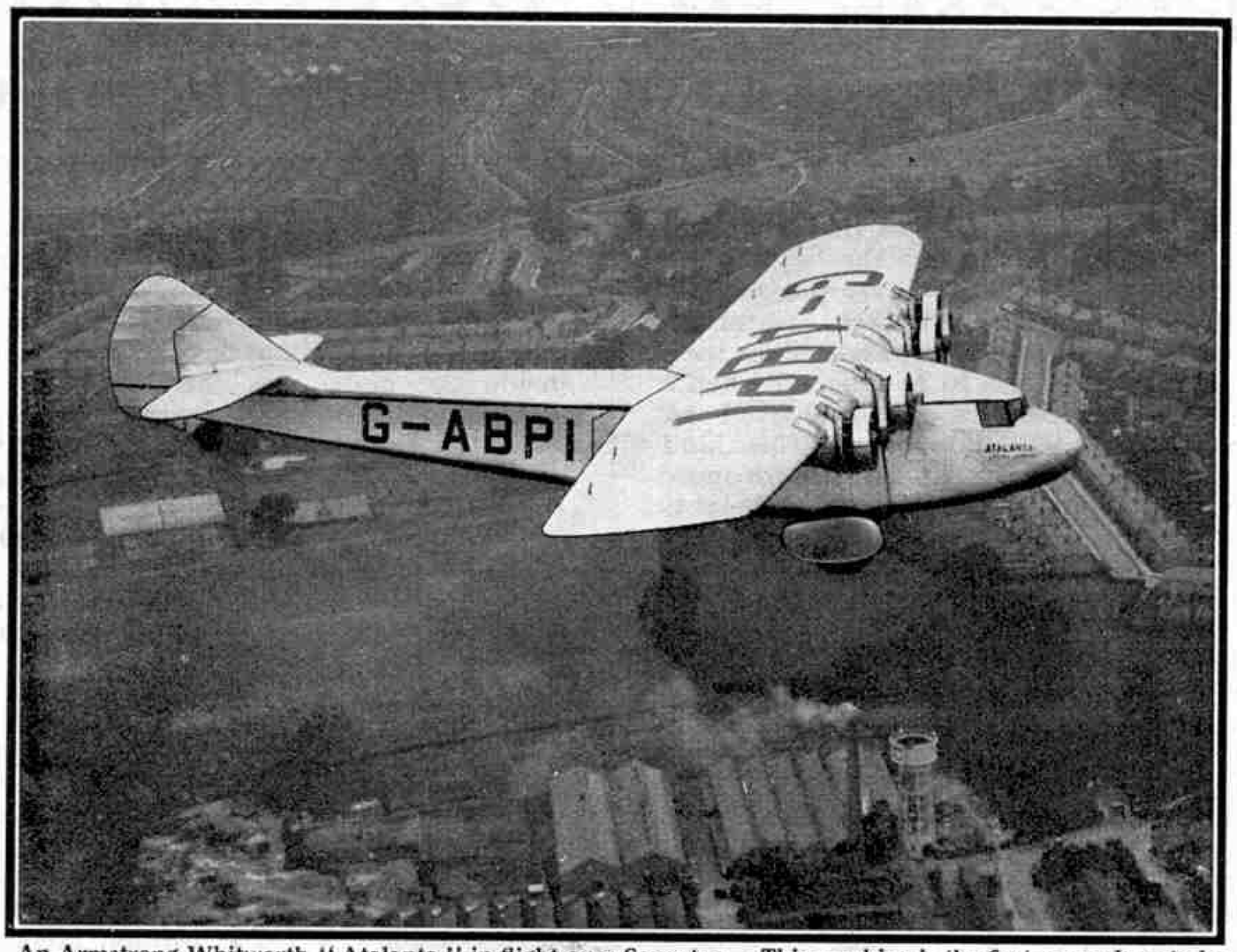
The photograph at the top of this page is a three-quarter front view of the first of the Armstrong Whitworth "Atalantas" to be constructed. For permission to publish this photograph and the upper one on the opposite page we are indebted to the courtesy of the Editor of "Flight." The complete list of Imperial Airways machines in the panel is given in response to repeated requests from readers. Eight "Atalantas" are shortly to be added to the fleet.

The remaining regular services of Imperial Airways are of great importance, for they provide a speedy means of transport between widely separated parts of the Empire. At present there are two of these services in operation, one between London and Karachi, India, and the other between London and Capetown. The advantages of these are enjoyed by those who wish to travel to and from Egypt, Palestine, Kenya, Tanganyika Territory and Rhodesia, in addition to those whose destinations are India or South Africa. The services are well organised and carry mail and passengers with a regularity that is a striking illustration of the reliability of modern aircraft backed up by an efficient system of maintenance. The Indian service has been in operation since March, 1929, and that to Capetown was inaugurated in January, 1932. Great extensions undoubtedly will be made when necessary, and experimental flights across India and beyond have already been made in preparation for the establishment of an air service to Australia. It is hoped to bring this in operation when world trade conditions are more favourable, and then a weekly service will be provided by means of which this distant part of the Empire may be reached in 11 or 12 days.

Travellers on the two great Empire routes now in operation do not fly throughout in the same machine, different aircraft carrying out duties on separate sections. In addition, the comfort of passengers is a great consideration, and their journeys by air are interrupted in order to enable them to obtain rest. Thus, on the outward journey, they fly from Croydon to Le Bourget, and then proceed to Brindisi by train, sleeping accommodation being provided. At Brindisi they embark in a flying boat in which they are carried to Athens, where they spend the night. If they are going to India they are flown to the Sea of Galilee, and complete their journey to Karachi by way of Rutbah Wells, Baghdad, Basra, Jask and Gwadar, arriving at their destination six days after leaving Croydon. Passengers for Capetown and other places in Africa are flown from Athens to Mirabella, Crete, and from there across the Mediterranean

Sea to Alexandria and Cairo. When the African route was opened the journey from Cairo to Capetown was made in a variety of types of landplanes and flying boats, but these will be displaced by Armstrong Whitworth "Atalanta" machines, a photograph of one of which is reproduced on this page.

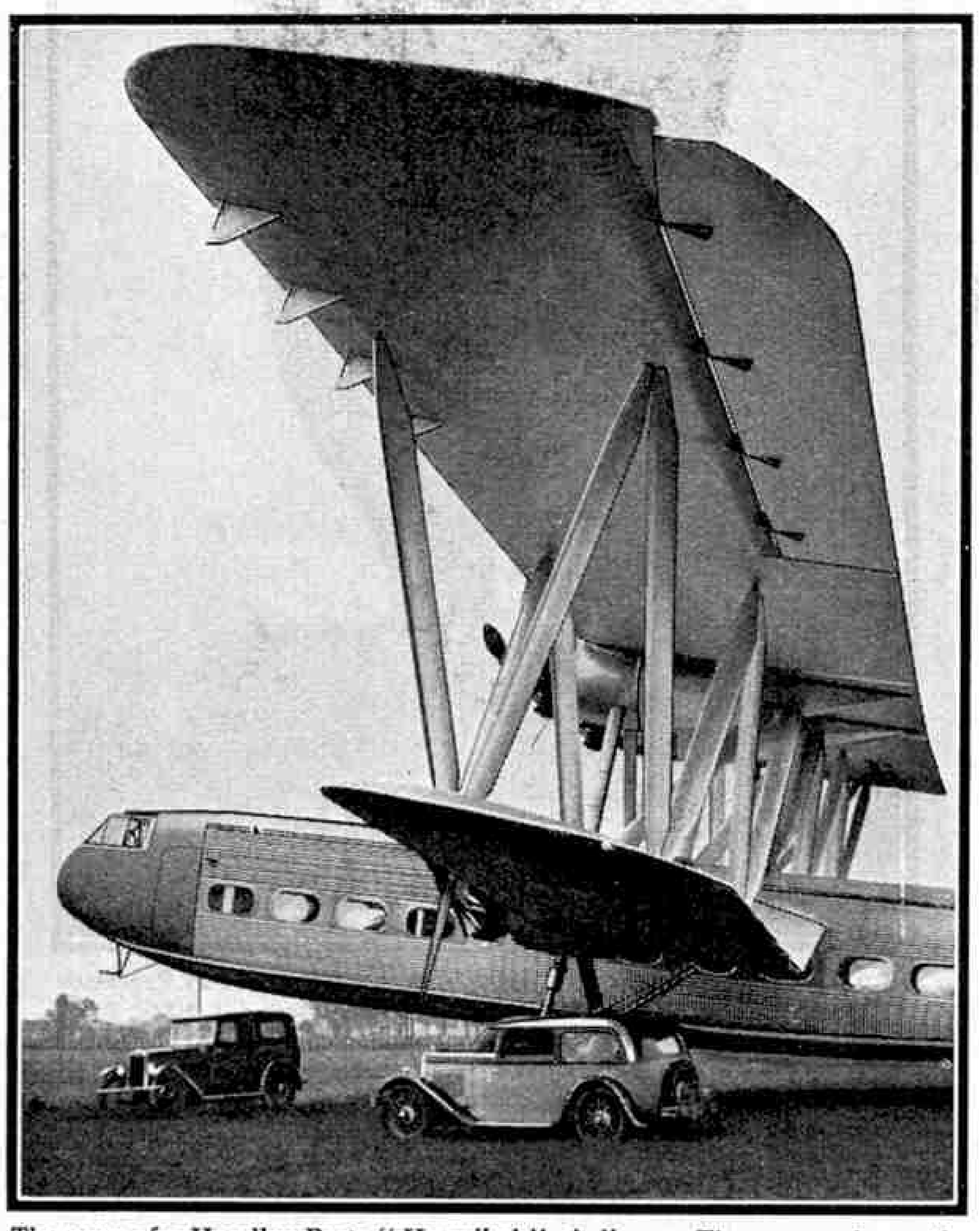
The introduction of "Atalantas" on the African section of the Capetown route will provide a typical instance of the care taken to employ machines that are specially adapted to the section of the route on which they are to be used. Many of the aerodromes established between Cairo and Capetown are at comparatively high altitudes, and the new aeroplane is specially designed for work under these conditions. It is equipped with four Armstrong Siddeley "Double Mongoose" engines that develop a total of 1,400 h.p. With any one engine stopped, the type is capable of maintaining a level course at any height below 7,000 ft., and of flying at a true air speed of at least 90 m.p.h. Actually, when the aeroplane is carrying full load and is cruising at an altitude of about 7,000 ft., the horse power needed to fly on four engines is less than two-thirds of the normal horse power developed by the engines at ground level. The aeroplane is designed to accommodate 17 passengers and their luggage, but from seven to nine will be carried on the African service in addition to a normal crew of three and a quantity of mail. We hope to publish an illustrated article describing this machine in an early issue of the *"M.M."*



An Armstrong Whitworth "Atalanta" in flight over Coventry. This machine is the first monoplane to be employed by Imperial Airways for operation over regular air lines.

The fleet of Imperial Airways has undergone interesting developments as the company has grown. The machines originally employed became too small to cope with the increasing traffic, and from time to time larger, more powerful and speedier machines have been introduced. For instance, when the twin-engined machines, such as the Handley Page W.8b and W.10, formerly employed between London and Paris, became inadequate, they were replaced by triple-engined aeroplanes of the Armstrong Whitworth "Argosy" type. The "Argosies" are equipped with three engines, developing 1,260 h.p., and this is an additional safeguard in cross-channel flying, for the machines are so designed that they can maintain height on any two engines if the third should fail, even when they are carrying a full load of passengers and mails.

Several "Argosies" are in regular operation, but larger and more powerful machines have now been introduced. These are the giant Handley Page biplanes of the "Hannibal" type.



The nose of a Handley Page "Hannibal" air liner. The cars underneath the wing and the fuselage give a good idea of the immense size of this machine. We are indebted to Imperial Airways Ltd., for this photograph.

The Handley Page machines were fully described on page 308 of the *"M.M."* for April 1931. They are equipped with four engines, and apparently the policy of Imperial Airways is to bring into use machines with this number of power units, for the Short "Kent" flying boats employed on the Mediterranean sections of the Empire air routes and the Armstrong Whitworth "Atalantas" also have four engines. Of the eight Handley Page "Hannibals" operated by Imperial Airways, four are employed on the service between London and Paris, and the remainder fly over the Asiatic portion of the route to Karachi, having been equipped specially in order to make them suitable for this purpose.

Passengers in modern air liners are provided with comfortable seats, and a journey by air is no longer an ordeal or even an adventure. In the past one of the greatest drawbacks was the noise from the engines, for even in cabin machines this made conversation between passengers almost impossible; but this difficulty has been overcome in the most recent machines of Imperial Airways. The cabins of these aircraft are provided with walls and roofs designed to damp out external noises and the machines themselves are designed to lessen the disturbances to passengers caused by their engines, with the result that the interior of the cabin in the most recent types of Imperial Airways liner is generally admitted to be as quiet as a compartment in an express train. The accommodation is more luxurious than that on a train.

An air line can only be operated in safety, particularly in bad weather, when advantage is taken of every means of informing pilots of their positions and of the weather conditions ahead of them. Elaborate weather forecasts are therefore prepared for the use of Imperial Airways pilots, and in addition all machines are equipped with wireless apparatus in order that communication may be maintained with Croydon, or with a wireless station in the vicinity of the aerodrome to which a pilot is flying. Special means are adopted to deal with bad weather conditions, and with fog, the greatest enemy of the airman. How flying is made safe in all weathers was fully described in the article that appeared on page 434 of the *"M.M."* for last June.

An elaborate testing and inspecting system has been built up at Croydon by the Engineering Department of Imperial Airways in order to ensure that machines in service are in perfect condition for flying. The engineers are arranged in shifts, so that a certain number are on duty day and night; and immediately an aeroplane lands it is handed over to a foreman and an inspector, who examine closely every part of the machine and test each engine separately. They make out reports, and if any defect is discovered mechanics are set to work upon it. Knowing that the safety of the people flying in the machine depends on the skill and care with which this work is carried out, both inspectors and mechanics do their duty very thoroughly, but in order to prevent any possible oversights a further inspection is made, and only on receipt of a final satisfactory report may a machine undertake another journey.

In addition to these precautions, all aeroplanes in service are inspected every morning before making a flight, and certificates of airworthiness for one day are issued, if they are found satisfactory. All machines are thoroughly overhauled after having flown a stated number of hours.

Exploring the Stratosphere

Balloon Ascent to a Height of 10½ Miles

THE earliest efforts to rise above the surface of the ground to considerable heights were made during the eighteenth century in simple balloons consisting of an envelope, containing heated air, from which hung a light wicker basket. Later the light gas hydrogen was used instead of heated air, and valves were introduced to enable a proportion of the gas to be released when a descent was to be made. Greater heights were achieved by throwing out sand carried as ballast. Balloons of this kind formed the only means of ascending into the atmosphere for more than 100 years, and in spite of their crudity wonderful heights were reached in them, the daring aeronauts at times being overcome by the rarity of the atmosphere and the intense cold they encountered.

The first aeroplane flight was made in 1903 by Orville Wright, and in the succeeding years heavier-than-air machines were developed so rapidly, and became so efficient, that interest in ordinary balloons largely died away. These balloons had the great disadvantage that they could not be steered, their huge and clumsy gas bags being at the mercy of the winds; and even dirigibles could not be compared with aeroplanes for speed and reliability. Two recent daring ascents in a specially-designed balloon have again drawn attention to the possibilities of exploring the upper regions of the atmosphere in craft lighter than air. During these ascents heights of 51,458 ft. and 54,450 ft. were reached, and the occupants of the balloons entered the stratosphere, the still and silent atmospheric region far above the greatest heights at which clouds are encountered.

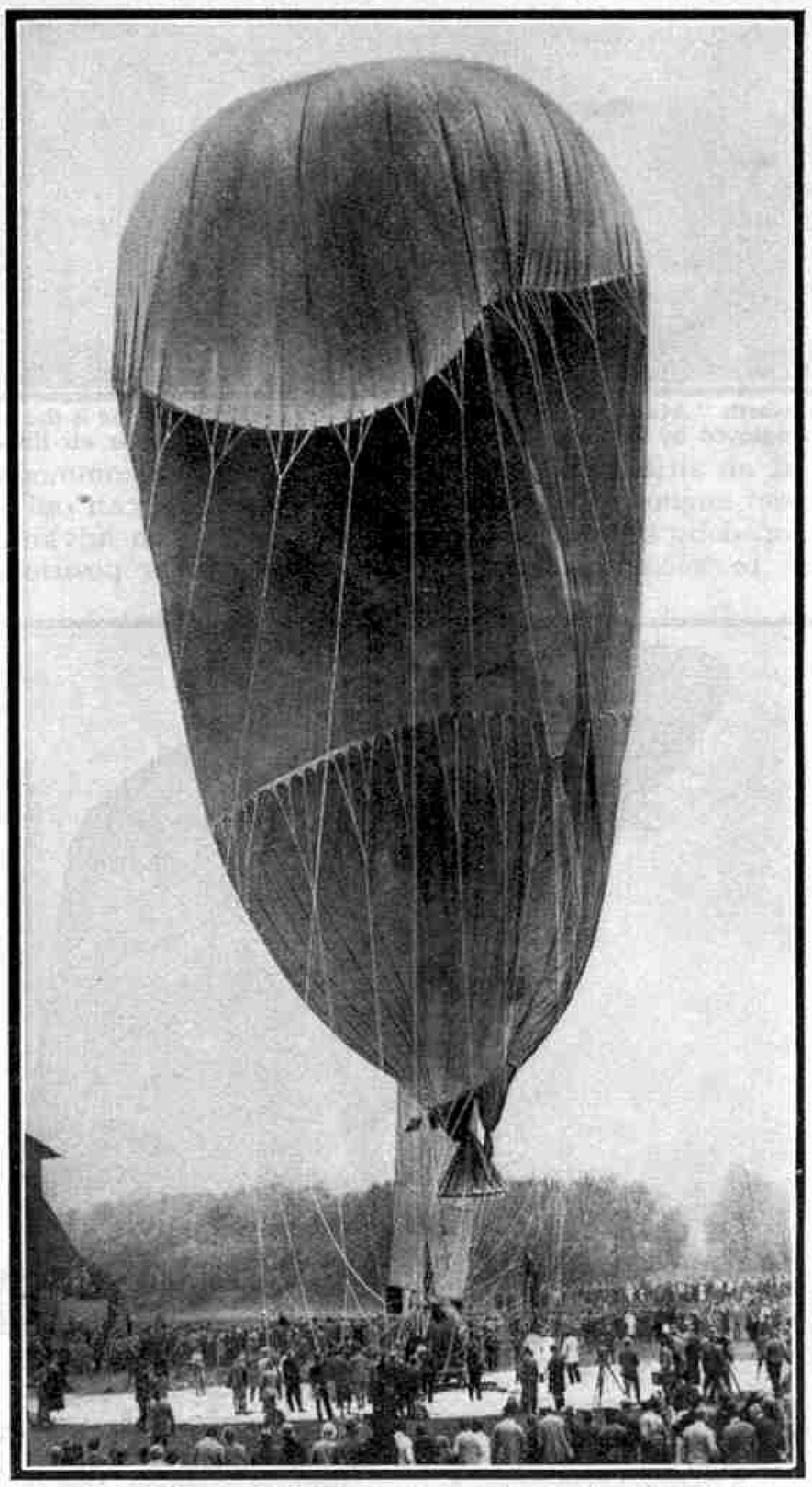
The hero of these adventures was Professor Piccard, of Brussels University. His first ascent was made on 27th May, 1931, in company with Dr. Kipfer. On that occasion his balloon rose from Augsburg to a height of 51,458 ft. before descending on a glacier in the Oetz valley in the Tyrol.

The second effort was made on 18th August of this year by Professor Piccard and Dr. M. Cosyns. The balloon started from Dubendorf Aerodrome, near Zurich, in Switzerland, and the height previously attained was exceeded by 3,992 ft. A new record of 54,450 ft., or nearly 10½ miles, was thus achieved, and it is interesting to note that this height is 11,284 ft., or more than two miles, above the greatest height yet reached in an aeroplane. It is almost twice the height of Mt. Everest, the highest mountain in the world.

During the ascent varying wind currents caused the balloon to follow an erratic course, and after crossing the Alps it was carried in the direction of the Adriatic. In order to avoid descending into that sea Professor Piccard then decided to come down, and eventually the balloon was brought to earth near Desenzano, on the shore of Lake Garda in Northern Italy. The two occupants of the gondola attached to the great envelope of the balloon had been nearly frozen during their stay in the upper atmosphere, and were so overcome by the summer heat of the Italian plains into which they were plunged that they almost collapsed, and were compelled to lie down in the shade in order to recover.

The balloon in which this amazing ascent was made differed in certain important respects from the familiar type that has been in use for many years. Instead of the usual wicker basket, a light aluminium globe was suspended from the envelope containing the lifting gas in order to provide accommodation for the crew. This globe could be completely shut off from the outer atmosphere, a necessary precaution in view of the fact that above the cloud level the atmosphere is so rare that it is impossible for human beings to live in it. A supply of oxygen with which to renew the atmosphere inside the globe was carried.

Another interesting feature concerned the envelope itself. When on the ground before the ascent this appeared to be only partially inflated, its width being small in comparison to its height. Its capacity was 14,000 cu.m., or a little more than 500,000 cu. ft.; but only 2,900 cu.m., or 104,000 cu. ft. of gas were actually contained in it. This small quantity was used in order to allow room for the expansion that takes place in the upper atmosphere, where the pressure is considerably less than at ground level. As the density of the atmosphere through which the balloon rose decreased, the gas inside expanded, and finally filled the balloon when it had reached a height of about 50,000 ft. The great envelope then formed a sphere, its width being twice that at ground level.



The giant balloon of 500,000 cu. ft. capacity employed by Professor Piccard in his record ascents. A general view of the scene prior to the first ascent from Augsburg, Bavaria.

There was very little room for the two aeronauts inside their aluminium globe, for this contained a complete mountaineering outfit, together with food and drink for several days, in addition to an extensive range of instruments and about 1,500 lb. of powdered lead for use as ballast. The mountaineering outfit was included because there was a possibility that the landing would be made at a great height in a mountain range, at a distance from populated centres, that might take considerable time to cover. The balloon descended on the Italian plains, however, and there assistance was obtained immediately. Professor Piccard thus was more fortunate than on his first flight, when he descended on a glacier and was unable to retrieve his globe until many months later.

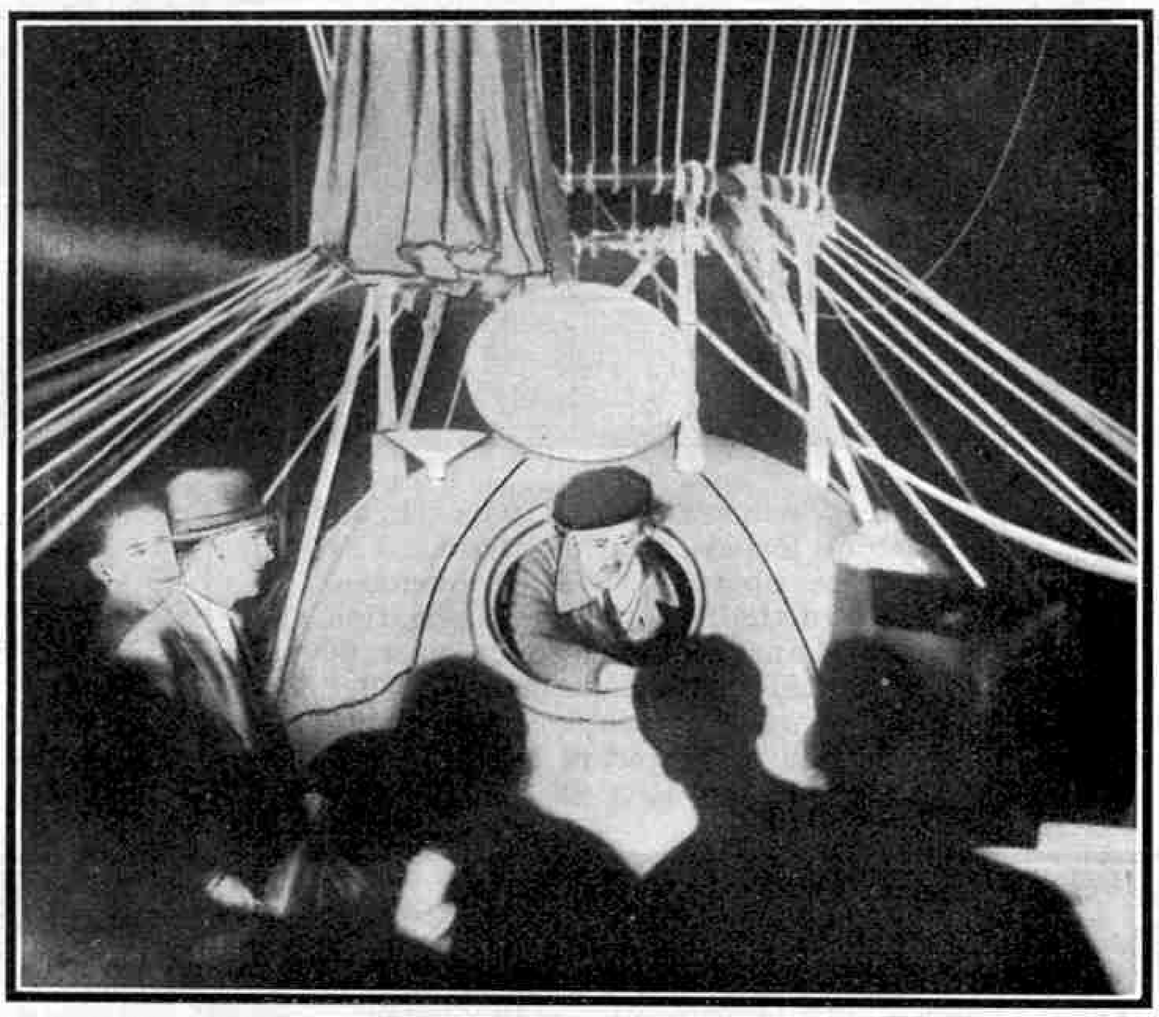
Professor Piccard's ascents have been pioneer voyages of exploration in the stratosphere, a part of the atmosphere of which at present very little is known. It is only 30 years since attention was first drawn to this calm region above the clouds, the highest of which are only 35,000 ft. above sea level. In it there is no water vapour, and the pressure is very low in its clear and rarified atmosphere, while the temperature is well below freezing point. The stratosphere, in fact, is a great belt of cold thin air about 12½ miles in depth, where the temperature is constant at about –60°F., or 92°F. below freezing point.

Below the stratosphere is the troposphere, the belt of the atmosphere in which we live, a stormy region full of clouds, and where the temperature shows great variation, being highest at the surface of the earth and decreasing with height. Above the stratosphere, stretching upward from a height of nearly 20 miles, is a mysterious region where the air is even thinner than in the stratosphere. How far this region extends is not known with certainty. Shooting stars at heights of more than 60 miles have been seen, showing that there is sufficient air at that height to cause them to become incandescent through friction, but the density must be as low as that in one of the so-called vacuum tubes employed in neon signs, or those used in laboratories for passing electric discharges through gases at very low pressures. The Aurora, an electrical glow or

discharge of this kind, has been observed at a height of about 56 miles.

This upper region of the atmosphere is remarkable for its high temperature. At a height of 40 miles above the ground this may be equal to that of boiling water, and the temperature at the distant outer limits of our atmosphere probably is even higher. No direct records are available to prove this, for as yet no large balloon capable of rising to such heights has been constructed, and the greatest height reached in a small balloon carrying automatic recording instruments is only 22 miles, or a few miles above the top of the stratosphere.

One reason for Professor Piccard's interest in the stratosphere is that he foresees the day when aeroplanes will fly through it as readily and easily as they now pass through the denser part of the atmosphere nearer the ground. Conditions at heights of more than six miles are certainly favourable for flying, for in the absence of clouds the region is one of perpetual sunshine, and very high speeds could be attained owing to the low resistance that would be offered by the thin air. Machines to fly in the rarified atmosphere would have to be specially designed, of course, for they would have to be totally enclosed in order to enable their crew and passengers to breathe. Artificial heating also would be necessary in view of the intense cold of the upper regions, and the machines would have to be painted black in order to enable them to absorb heat from the Sun's rays. The construction of aeroplanes for this purpose has already been under consideration. Professor Piccard makes the interesting suggestion that the aeroplane of the future will use engines of the ordinary type when traversing the denser regions of the atmosphere, but will depend on rockets to propel it through the stratosphere at speeds far exceeding those of the fastest racing machines of to-day.



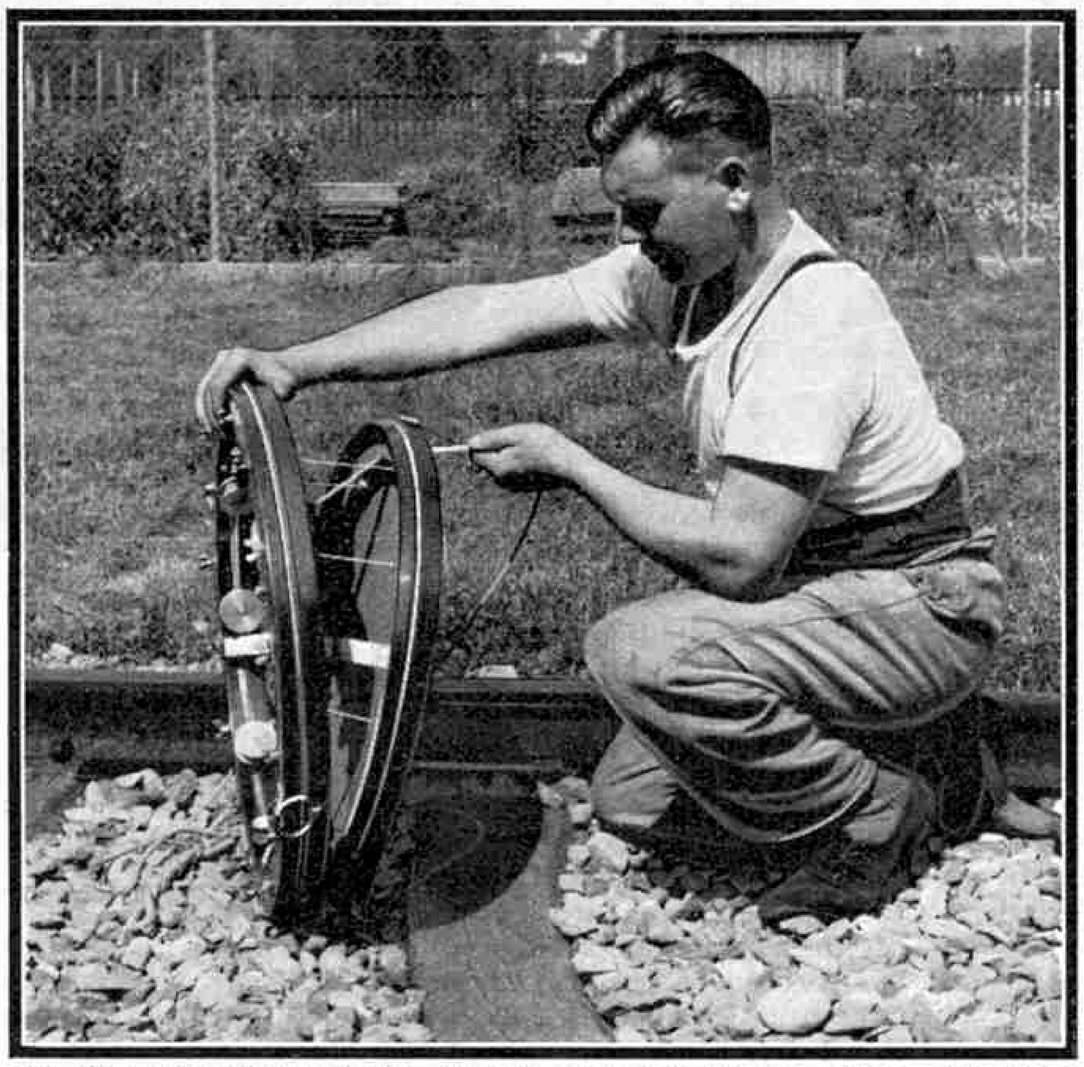
Professor Piccard in the aluminium sphere of his balloon immediately before his record ascent to a height of 54,450 ft. from Zürich, Switzerland.

Professor Piccard's main object, however, was to obtain scientific records at the great height to which his balloon rose. His instruments registered the temperature and pressure, and recorded the electric state of the atmosphere. Even inside the aluminium globe the atmosphere fell as low as –32.8 deg. F., or 64.8 deg.F. below freezing point. One reason for this was that the globe was painted white in order to prevent it from absorbing the heat of the Sun's rays. For his previous trip Professor Piccard had half of it painted black, with the result that the temperature inside rose too high to be comfortable, for black objects take up radiant heat more readily than white ones.

The globe carried also instruments for measuring the intensity of the cosmic rays, the mysterious radiations that bombard the Earth from some unknown source in space. These radiations resemble X-rays, visible light, and wireless waves in being vibrations in the ether. Their wavelength is considerably less than that of any other known radiation, however, and consequently they are much more penetrative than X-rays, or than the similar gamma rays produced by radium and other radio-active substances. Even at ground level they are capable of penetrating through 16 ft. of lead. A proportion of the radiations is absorbed in passing through the atmosphere, and therefore the radiations are stronger at great heights. So intense are they at the height reached by Professor Piccard's balloon that the instrument by means of which he detected them produced a sound that he described as resembling that made by rain falling on a metal plate.

The measurements that were obtained in this record balloon ascent may help to clear up the fascinating mystery of the origin of the cosmic rays. These reach the Earth with equal intensity by night and by day, thus showing that they do not originate in the Sun; and they come from all sides, and therefore are not produced in the Milky Way, or in any other special part of the universe. They clearly must come from space itself, and it is suggested that they are the result of the building-up of matter. It is almost certain that the various atoms are built up of hydrogen and helium, and the most common process of this kind is the formation of the helium atom from four atoms of hydrogen. When this union takes place a certain amount of energy is set free, and this is shot out in the form of radiations of short wavelength and great penetrative power. If this view of the cosmic rays is correct, they may therefore be regarded as wireless signals of the creation in space of heavier atoms from atoms of hydrogen.

It is impossible during a single ascent to obtain all the information that is required to solve the puzzle of the cosmic rays, of course, and other ascents and aeroplane flights to various heights will be necessary in order to measure their intensity at different places. For instance, an ascent carried out near one of the magnetic poles would be very useful. The earth's magnetic field does not influence the rays at all, for their intensity above Pasadena, in Southern California, is the same as that above Churchill, on the shores of Hudson Bay, the nearest populated centre to the north magnetic pole. But in their path through the atmosphere the rays come into collision with the atoms of the gases composing it, and these collisions result in the production of secondary rays that are affected by the earth's magnetic field and would enter it most abundantly in the neighbourhood of the magnetic poles.



The giant valve of the balloon. This was opened in order to release a proportion of gas when the time came to descend.

Recently an aeroplane flight at a height of 21,000 ft. was carried out in Northern Manitoba in order to obtain new knowledge of the cosmic rays and of effects produced in the neighbourhood of the magnetic pole. This flight was made under the direction of Professor R. A. Millikan, one of the discoverers of the rays.

It is probable that Professor Piccard himself will make his next ascent in the Hudson Bay region, and there he will be able to reach heights far greater than 21,000 ft. in order to measure the intensity of the cosmic rays. He will also be in a position to trace the presence of secondary rays, and the result of the measurements he will make near the north magnetic pole may be to confirm the belief that the cosmic rays themselves are the outward signs of the building up of matter

Power Development on St. Lawrence

As mentioned on the Editorial page of last month's "*M.M.*," the completion of the Welland Ship Canal, described on page 736 of this issue, is to be followed by the improvement of navigation between Lake Ontario and Montreal. This section of the St. Lawrence River is 183 miles in length, and where navigation is interrupted by rapids, canals with a depth of 27 ft. are to be constructed, while immense hydro-electric power stations are to be built in order to take advantage of the fall in water level. The cost of the work on the international portion of the waterway, including the reconstruction of the Welland Ship Canal, is to be borne equally by Canada and the United States, and the power to be developed also will be divided equally between the two countries.

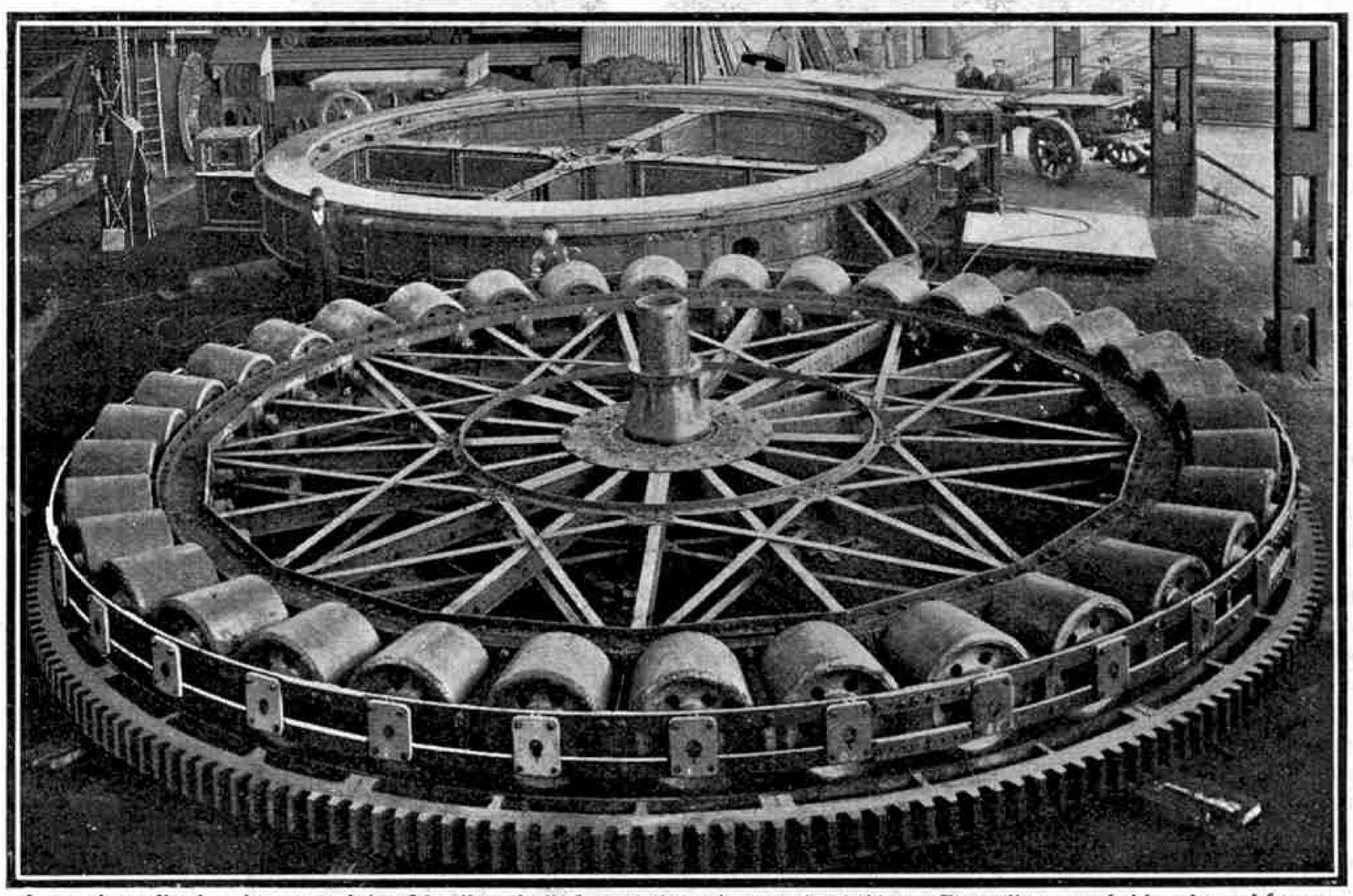
The international section includes rapids in the St. Lawrence that give a total drop in level of 92 ft. Two dams are to be erected across the river in this section, advantage being taken of islands in each case to shorten the length of the dam required. The upper dam will cross the river at Crysler Island, and will give a head of water of 24 ft. The two power plants to be erected at this point will give a total of 593,000 h.p. and the navigation canal, which will be on the Canadian side of the river, will have a single lock. The second dam will be erected at Barnhart Island, and the water channel will be entirely in United States territory. The average head of water available will be 60 ft. and a total output of 1,607,000 h.p. is anticipated.

The lower portion of the river flows through the province of Quebec and canals are necessary to avoid the rapids between Lake St. Francis and Lake St. Louis, which are 18 miles in length, and the Lachine Rapids, near Montreal. The first of these obstacles will be overcome by means of the Beauharnois Navigation and Power Canal, referred to on page 694 of the "*M.M.*" for September, 1930. The head of water available in this section is 80 ft., and an output of 500,000 h.p., with an ultimate capacity of 2,000,000 h.p., is expected from it. The fall over the Lachine Rapids section is 32 ft. and this will be employed to develop 1,000,000 h.p. The necessary expenditure in the Quebec section will be met by private companies.

The cost of the entire scheme is estimated at £117,000,000, which is greater than the expenditure on the construction of the Panama Canal; and the work is expected to occupy 10 years. When it is completed, a navigable waterway 27 ft. in depth will be completed between Montreal and the Great Lakes, and the total hydro-electric power developed will be about 5,000,000 h.p.

* * * *

Four new wireless transmitting stations to be constructed in France will be among the most powerful in Europe. One is to replace the Ecole Supérieure and two will be built at Toulouse and Lyons. The site for the fourth has not yet been fixed.



A massive roller bearing, containing 36 rollers, built for rotating a large swing bridge. The rollers, carried in a braced frame, support the steel ring shown in the background. The Meccano Roller Bearing is a splendid reproduction in miniature of this important type of engineering structure.

Ship Model Testing Tank Built in Holland

A marine testing tank that has been constructed in Holland at a cost of about £56,000 is the first of its kind to be built in that country. It is of ferro-concrete and, contrary to normal practice, is not embedded in the ground to give rigidity, this being obtained by the use of deep-web frames. The tank is usually employed to test models made of paraffin wax from 16 ft. to 18 ft. in length, but the machine on which they are cut is capable of producing models up to 26.5 ft. in length.

The water basin of the tank is 530 ft. in length and 34.24 ft. in breadth. Its depth is 18 ft., this measurement being taken over a false bottom 2 ft. above the base. When the full depth of water is used there is a clear run of 410 ft., and in order to allow full advantage to be taken of this, the dock at the end from which models start on their trial runs has been placed on the centre line of the tank. The models are hauled by means of a travelling carriage, and two oil buffers are provided to stop this at the end of each run. The tank may be extended to a length of 900 ft. if this becomes necessary.

Railway Bridge Replaced in Record Time

On 17th July last an L.M.S.R. bridge crossing the Buxton-Bakewell road near Buxton was replaced in record time. The last train passed over the old bridge at 12.35 a.m., and by 7.30 a.m. on the same day a new steel structure weighing 700 tons had been placed in position, ready to be crossed by the trains of the normal Sunday service. The new bridge had previously been erected on ground behind the old one. There it rested on ball bearing cranks until the existing structure had been demolished, and it was then rolled quickly into position.

New Type of High-Pressure Marine Engine

A new type of high-pressure marine steam engine has been produced by a West Hartlepool firm of engineers. This has been named the "Quadropod," and is a four-cylinder quadruple expansion engine in which special attention has been paid to low steam consumption and maintenance costs, simplicity in design and reliability in operation. It differs from an ordinary quadruple or triple expansion engine in the manner in which steam is distributed, and in the use of cam-actuated drop valves instead of the usual slide or piston valves. The four cylinders make up two units, one consisting of the high-pressure and the first intermediate-pressure cylinders, and the other of the second intermediate-pressure and low-pressure cylinders. A steam receiver is fitted between the two units.

The first engine of this type is fitted in the "*Kepwickhall*," an 8,600-ton cargo steamer owned by the West Hartlepool Steam Navigation Company. The high-pressure cylinder of this engine is 20 in. in diameter, the low-pressure cylinder is 61½ in., and the intermediate cylinders 28½ in. and 41½ in. in diameter respectively. All cylinders have a stroke of 48½ in., and the engine is designed to have a maximum output of about 2,100 h.p. at 80 r.p.m., which should give the vessel in which it is fitted a speed of 10½ knots.

World's Largest Gear Wheel

What is claimed to be the largest gear wheel in the world has been constructed by Engrenages Citröen, of Paris. The wheel is 48 tons in weight, and has a diameter of 5.472 m. or about 17 ft. 8 in., and is 770 mm. or 2 ft. 6 in. in width. It has 152 teeth, the faces of which are 650 mm., or 2 ft. 1 in. in width, and the pitch is 4.4 in. The small gear wheel with which it meshes has 24 teeth and its speed is 190 r.p.m., while that of the larger one is 30 r.p.m. The wheel will normally transmit power up to 2,000 h.p., but this may safely be increased to 4,000 h.p. for short intervals.

A.E.C. Lorry Awarded War Office Subsidy

A heavy duty lorry produced by Associated Equipment Co. Ltd., and named the "Marshall," has been awarded a War Office subsidy after exhaustive tests on rough hills in Wales. The lorry is fitted with six wheels, all of which may be driven. Creeper tracks also may be fitted when desired, and a winch is provided as a standard fitting by means of which the lorry can haul itself or other vehicles out of bad places. The "Marshall" is capable of hauling a load of five tons on ordinary roads, and of three tons when undertaking cross-country work where there are no roads.

Harnessing Victoria Falls

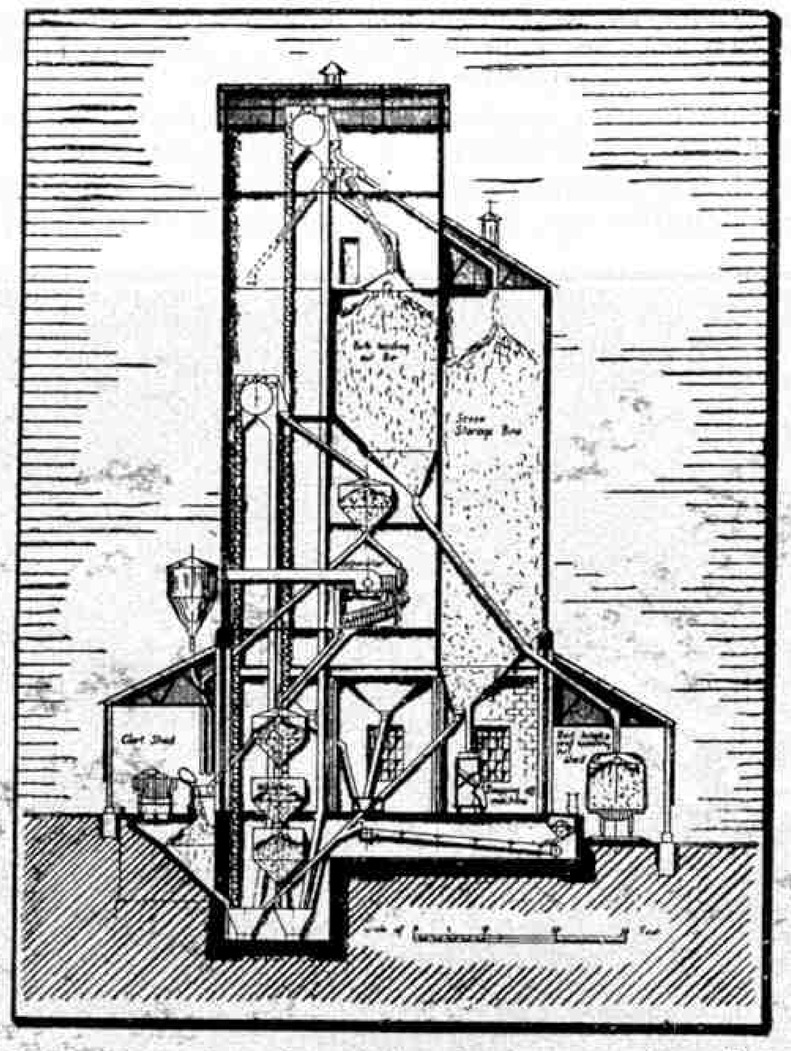
Electric light and power for the municipality of Livingstone, the capital of Northern Rhodesia, is to be provided by a hydro-electric power station at Victoria Falls. A great deal of power could be generated by the new power house, but it would be necessary for the power to be carried many hundreds of miles before it could be consumed on a large scale.

The Motor Liner "*Highland Patriot*"

A new twin-screw motor liner, the "*Highland Patriot*," has been constructed by Harland & Wolff Ltd., for the Nelson Steam Navigation Co. Ltd. The vessel is built to the same dimensions as the "*Highland Monarch*," a sister ship completed in 1928 and described on page 25 of the "*M.M.*" for January 1929. She is 520 ft. in length between perpendiculars, and 69 ft. in moulded breadth. Her gross tonnage is 14,157, and there is accommodation on board for 135 first-class and 66 intermediate-class passengers, together with about 600 emigrants.

The vessel is equipped with two sets of Harland-B. & W. double-acting, four-stroke cycle Diesel engines, each of the eight-cylinder type and developing about 4,800 b.h.p. They give the liner a service speed of about 15 knots. The whole of the auxiliary machinery is driven by electricity, the necessary current being provided by four 200 k.w., 220 volt, Diesel generating sets.

A huge structure to advertise a well-known French domestic cooker, which was one of the features of a Marseilles Fair.



Sectional drawing of a grain elevator, or silo. The material is received at the left, and after being weighed is fed to a bucket conveyor that carries it up to the top of the structure. There it is emptied into one of the huge storage bins from which, when required, it is discharged through chutes either into sacks or in bulk into wagons, as shown on the right of the illustration.

The "Sea Lion" Motor Boat Engine

Engineers of the Power Boat Co. Ltd., of Southampton, recently have converted a Napier "Lion" aero engine for use in a motor boat, and in its new form the engine will be known as the "Sea Lion." It employs three banks of cylinders arranged in broad-arrow shape, and has a designed output of 500 h.p. at 2,000 r.p.m. Similar engines developing 425 h.p. and 400 h.p. respectively also are to be constructed, and all models are expected to be capable of running for 300 hours without overhaul.

The marine type of the "Lion" differs from that used in aircraft in the type of water cooling pipes provided. In addition, different carburetters are used, and the crankshaft journal has been extended in order to allow reverse and starting gears to be fitted.

Hydro-Electric Power in North Ontario

It is expected that power generated by the Abitibi Canyon Development Scheme, Canada, will become available this month. The dam is on the lower Abitibi River, north of Cochrane, Ontario, and provides a head of 237 ft. The plant installed is designed to include five units each of which will develop 66,000 h.p. and thus the total power to be developed will be 330,000 h.p.

Work on this scheme was commenced in August 1930. The construction of the dam was begun in April of the following year and while it was in progress and the site of the power house was being prepared, the flow of the river was diverted by means of two tunnels.

Large Turbines for Russian Station

Four turbines that are to be employed at a new hydro-electric power station in Russia will be fitted with runners that will be among the largest in the world, for they will be 24 ft. 4 in. in diameter. They will be of the four-bladed type, and will be made of stainless steel that has been specially produced by a Swedish firm. The Soviet Government only decided to employ this metal after examining reports on stainless steel runners already in operation. A test runner also was subjected to a number of exhaustive tests in order to prove the suitability of the steel.

The guide vane element of the turbines will be embedded in concrete. The total downward thrust of each set will amount to approximately 1,330 tons. This is made up of the weight of the set together with the hydraulic thrust on the runner plates. The turbines will normally develop 37,000 h.p. when running at a speed of 75 r.p.m., but when the maximum head of water available at the station is used the turbines will be capable of developing 42,000 h.p.

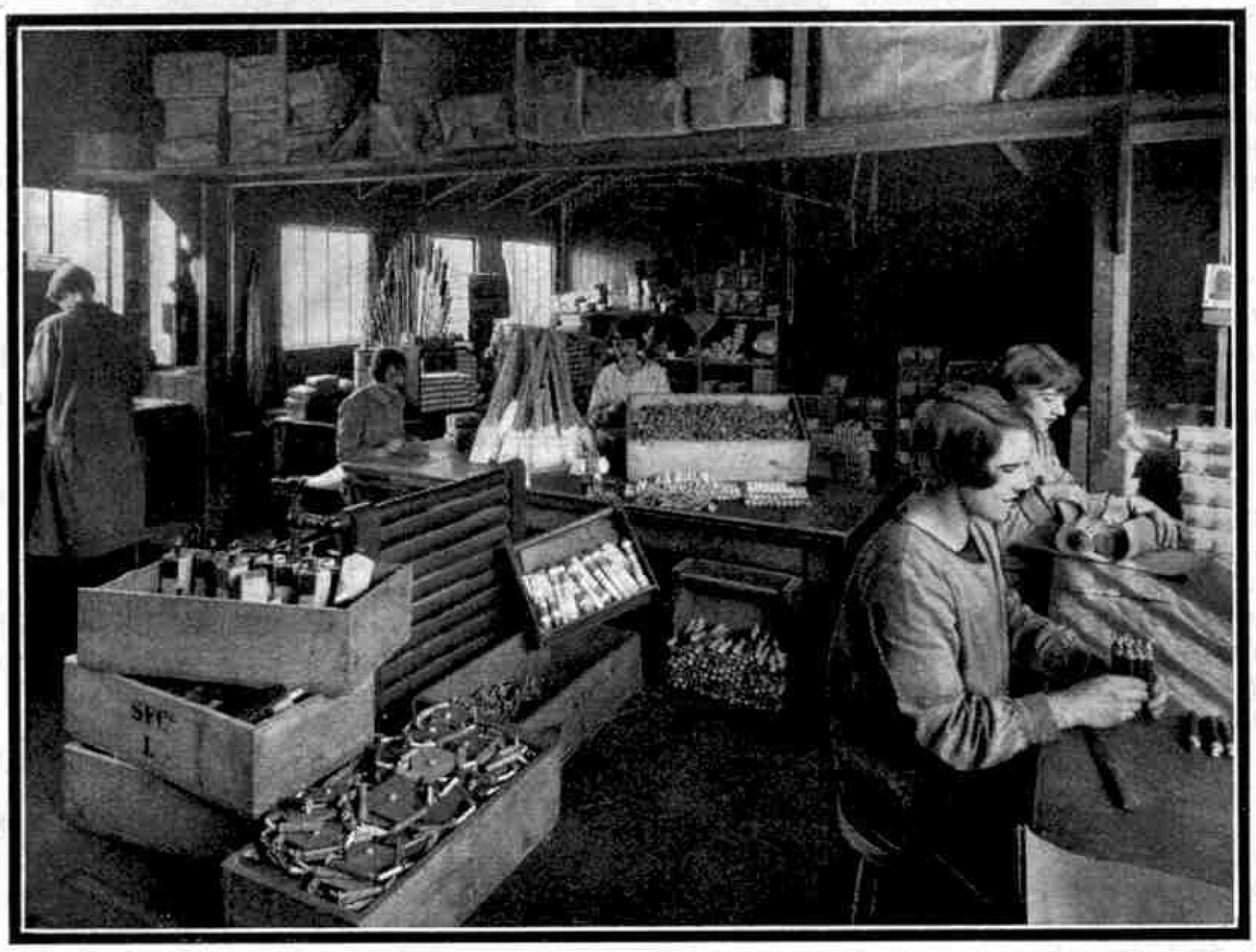
The hydro-electric station where these turbines are to be installed is being built on the River Svir, a river some 125 miles in length which flows between Lake Onega and Lake Ladoga in Russia. It is part of a scheme that provides for the erection of three large power stations on the same river. Only one station is to be built at first, however, and work has already begun on the first two units that are to be installed in it. These probably will be put into service during 1933.

HOW THINGS ARE MADE:

Fireworks: Preparing for "The Fifth"

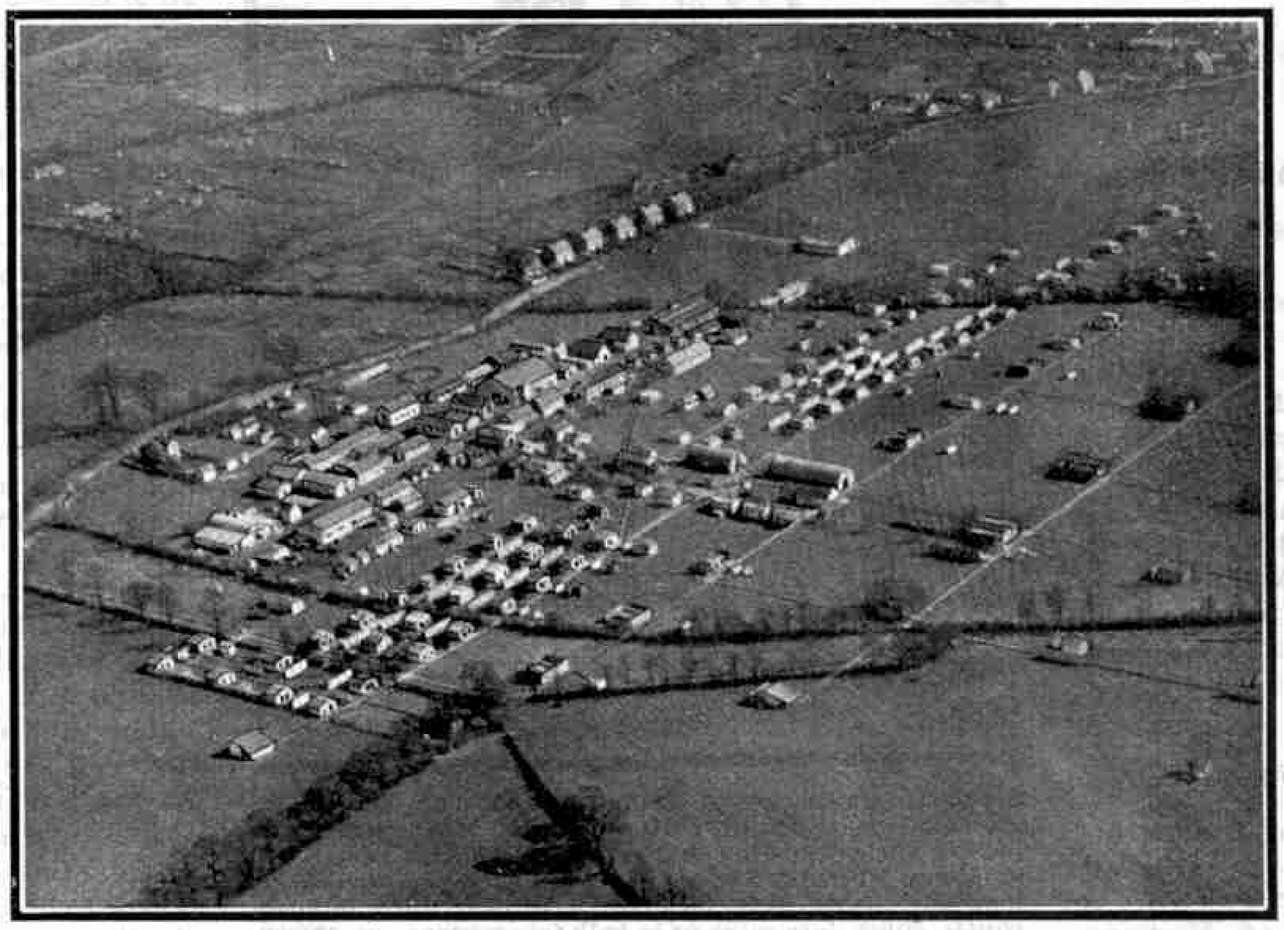
FIREWORK-MAKING is among the oldest of the world's industries. Long before Europe discovered the secret of gunpowder in the 13th century the Chinese had grown old in the art of pyrotechny, and for very many centuries now no great public celebration has been complete without its firework display. In the British Isles such spectacles have steadily increased in popularity, and now several large factories and some thousands of workpeople are engaged throughout the year working at high pressure to provide fireworks for large numbers of public displays and to satisfy the British boy's demand for "big bangs" on Guy Fawkes night.

It is an interesting fact that in spite of the rapid growth in the output of firework factories, the production methods have changed comparatively little. In very few of the processes involved is it possible to employ machinery. The product is a dangerous one, and, quite apart from the fact that better results are achieved by hand work, precaution against explosion dictates that the bulk of the work shall be done by hand. The very term "factory" is something of a misnomer, for actually a firework factory consists of a series of separate small workshops, often accommodating no more than two workers. The advantage of this arrangement in case of explosion is obvious, but it is remarkable how little actual danger really exists, for the most strict precautions are taken to guard against the possibility of sparks or fire.



Girls in the Standard Factory are seen here bundling and packing fireworks preparatory to despatch. This photograph and the lower one on the following page are reproduced by courtesy of Standard Fireworks Ltd., Huddersfield.

The workpeople are required always to wear special nail-less shoes, and visitors are provided with rubber overshoes. The workshop floors and benches are covered with linoleum fastened down with copper nails, the tools employed are of wood or soft metal, and the workshops are swept at least three times a day, for a tiny speck of grit might cause a serious accident. It is recorded that Messrs. Brock and Company, the famous Sutton firm of firework makers, were fined heavily on one occasion because a cobweb was discovered in one of their workshops! The cobweb itself was not dangerous, but it afforded evidence that the workshop had not been cleaned in the thorough manner laid down by law.



An aerial view of the Brock factory at Sutton. The metal screens separating individual workshops are clearly shown. For this photograph and the upper one on the next page we are indebted to C. T. Brock & Company Ltd.

Two of the largest works in the Kingdom are those of Messrs. C. T. Brock & Company and Messrs. Standard Fireworks. The Brock factory at Sutton, Surrey, consists of between 200 and 300 buildings and, viewed from the air, has the appearance of a small town in one of the western American States. At the gates one notices a large cylinder not unlike a dustbin. This is the largest fireworks mortar ever constructed. It is 25 in. in diameter and can fire to a height of 800 ft. a shell weighing over 200 lb. which, on exploding, covers an area of 15 acres of sky! Actually this mortar is fired only on rare occasions.

The factory is divided into three main sections—the non-explosives area, the explosives area and the magazine area. In the non-explosives area are the sawmills, the blacksmiths' and fitters' shops, the paper cutting shop, stores for paper and chemicals, the buildings in which are rolled paper tubes or cases in which the firework composition is contained, timber stores, Christmas cracker-making plant, the canteen, and the set-piece-making shop.

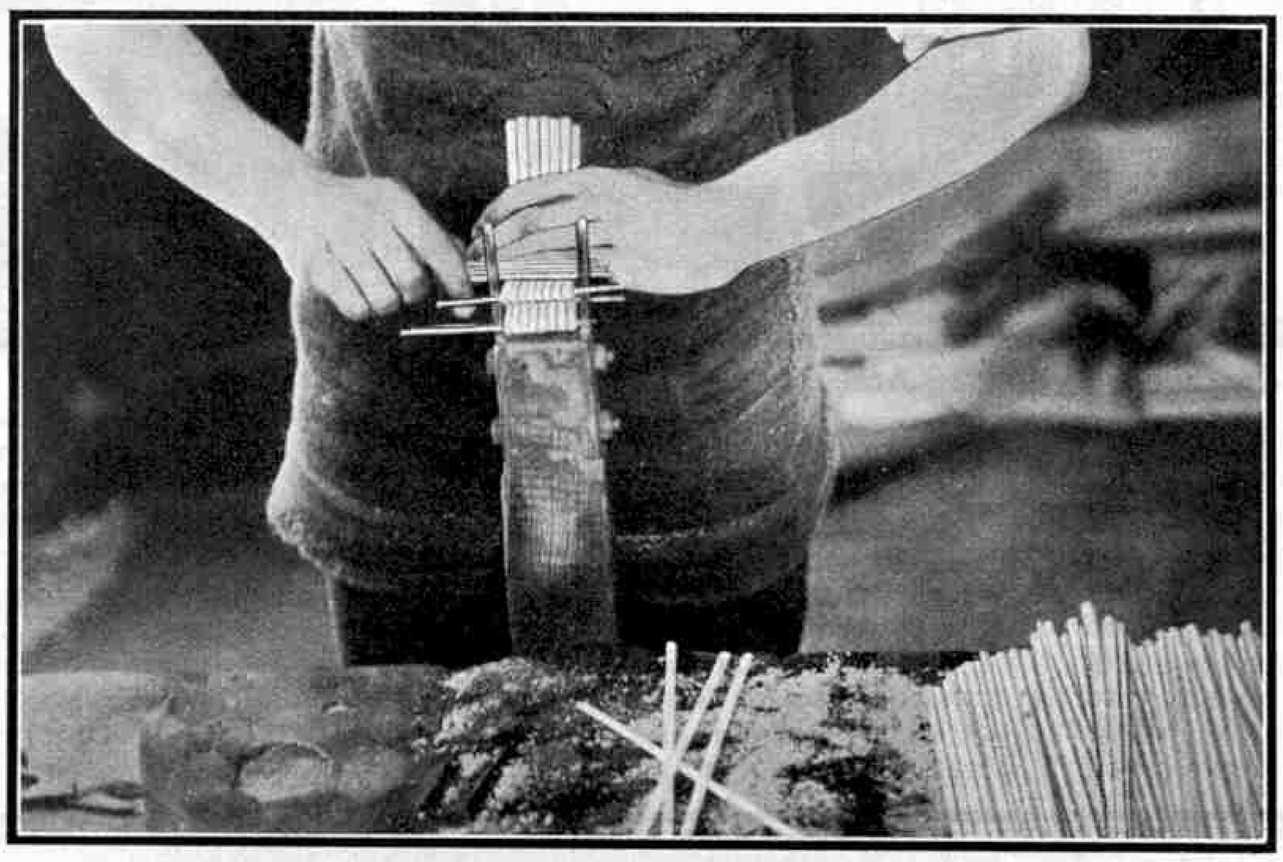
The last-named building is where the famous Crystal Palace set-pieces are drawn out on a floor 160 ft. in length by 60 ft. in width. Near this building are stored in racks the frames on which are outlined the pictures that form the set-pieces—battleships, portraits of members of the Royal family, outlines of volcanoes, fountains, etc. There also is the woodwork of the mechanical fireworks, such as acrobats, boxers, fighting cats, racehorses, greyhounds, and the machinery of the huge wheels and various other devices that help to make up the wonderful display. Near by is the shed in which are stored the mortars from which the bombshells are fired, many of these being of considerable size, ranging up to 16 in. in diameter. Close at hand is the printing works, where posters and the coloured jackets for the 5th of November fireworks are printed.

The explosives area is divided into two parts, and here the actual firework-making goes on. This part of the works is divided by a wide road into two sections, known as the "colour" side and the "black" side respectively. Workpeople on these two sides never mix, and no tool or implement used in one is ever taken to the other. On the colour side are made the coloured fire stars that contain potassium chlorate; on the other side the golden fountains and white fire stars in which the ingredients of gunpowder,

potassium nitrate, sulphur and charcoal are used. It is to the presence of the charcoal which, in a finely powdered state is rather apt to spread itself, that the name "black" side is due. Potassium chlorate and sulphur if mixed are liable to go off at any time, and their use together in firework compositions is forbidden by law. It is with the object of preventing any chance of these two chemicals meeting that this definite division of the factory is made.

The work buildings in this area form two main rows connected by tram lines, on which run the trucks that take the finished work to the drying rooms and magazines. The tramway system has a total length of about six miles. The buildings themselves generally consist of two compartments, each of which has a door at each end, and from it all iron and steel is eliminated.

Hanging on the wall in each compartment is a board setting out the operations for which that compartment is licensed, and the quantity of explosive material allowed in it. This quantity, and also the number of persons employed in a building, varies with the nature of the work, in some cases being as little as a few ounces of composition and only one individual. The magazines, 33 in number, are separated by considerable intervals, and occupy an area of many acres. They are surrounded by trees that would lessen the effect of an explosion in the very unlikely event of one taking place.



This illustration shows the operation of shaping crackers, commonly known as "rip-raps," at the Brock Factory.

The Standard Fireworks factory situated high up on the moors near Huddersfield, not far from the Moorside Edge broadcasting station, is laid out on lines similar to the Brock factory, although it differs in many points of detail. Here also there is nothing spectacular about the manufacturing processes. In one long workshop there are some 50 girls deftly rolling cases for all manner of ingenious fireworks. Sheets of pasteboard lie on a table in front of each girl, who has a round stick in her hand. A flick of the wrist, a twist of the fingers, and a smear of glue, and a long roll of paper tube is ready and is quickly thrown into a basket. As soon as this is full it is taken away, and the tubes are sawn into lengths under rapidly whirling knife-blades. Next the tubes pass through a machine that twists and seals the butt-end, and so to another basket ready for the drying ovens before filling. That in brief is the making of the case. Squibs, crackers, sparklers, rip-raps and catherine wheels are all made in this manner.

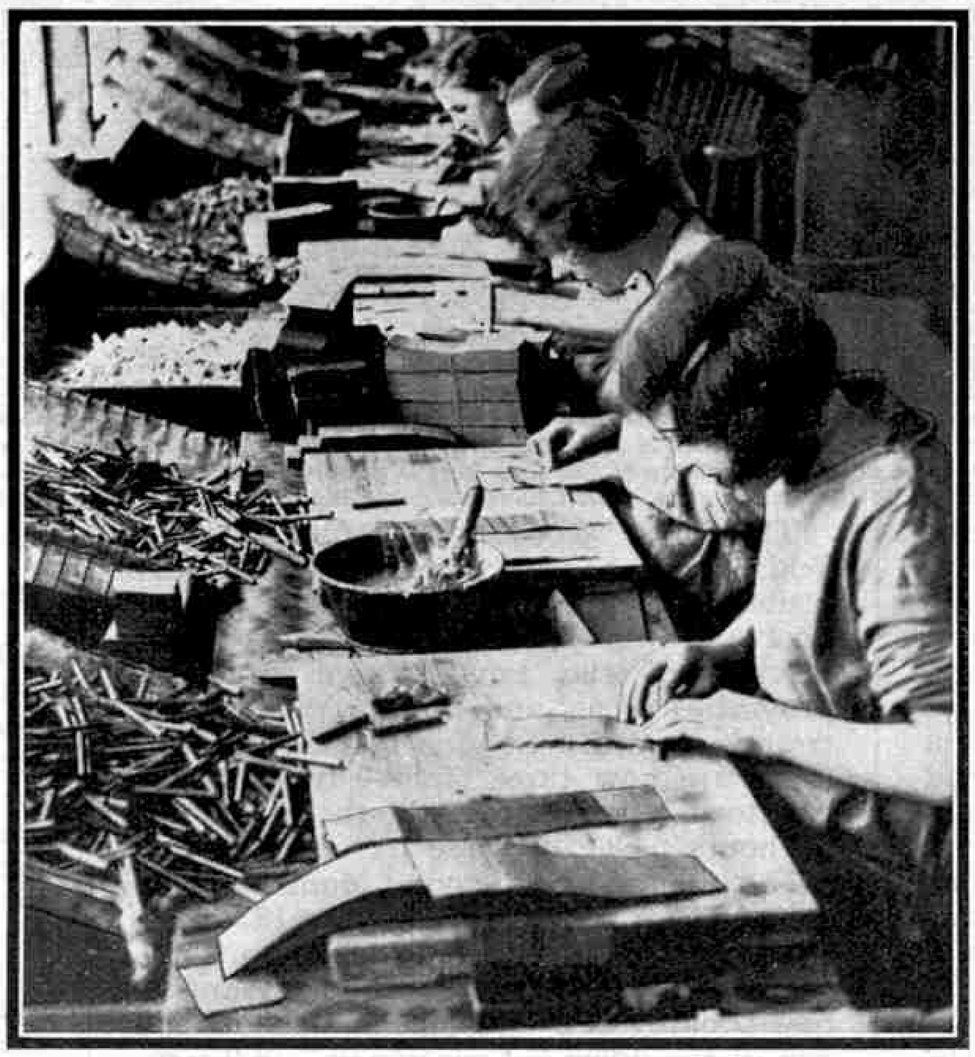
In the filling shops the operations differ very materially according to the kind of firework. Types of powder vary, and ingredients for bangs, for lighted balls and sparks are added each in its proper place.

The baskets of finished fireworks then pass into the counting and bundling room, where they are quickly seized by girls who, with remarkable accuracy, pick them up in loads of twelve and tie them into bundles. It is almost uncanny to watch the girls pick up twelve correctly every time, but with constant practice the hand accustoms itself to the feel of a dozen and automatically rejects eleven or thirteen as not correct.

In the course of our journey round the works we encounter a queer-looking barrow, somewhat similar to the restaurant wagons seen on railway station platforms, but in this case carrying countless rows of wires, stuck vertically in a wire tray and looking like huge wire hairbrushes. These wires are to be made into sparklers, those fascinating indoor fireworks that throw off bright white sparks and yet are perfectly safe because the sparks do not burn and the ends of the sparklers do not drop. The process of manufacture is simple but interesting. Each tray of wires is dipped into a solution that looks very like grey mud, so that one end of each wire is heavily coated, and the trays of coated wires are then finished by being placed in a hot oven for a certain period. When work is in full swing more than 20 miles of wire are used each day in the manufacture of sparklers.

The enormous quantities of fireworks consumed in a year can best be realised from a brief survey of some of the amounts of materials used in 12 months. The Standard factory alone consumes more than 100,000 lb. of gunpowder, 70,000 lb. of saltpetre, 250 tons of straw-board and paper for casings, and five tons of glue—and the bulk of the product goes up in smoke in the course of that glorious hour or two on Guy Fawkes night.

The use of fireworks for other purposes than amusement must not be overlooked. At sea they are employed in great variety to provide identification signals for vessels passing Lloyd's signal stations at night. Such signals consist of hand lights, Roman candles, rockets, or Coston lights, the last-named being small hand lights arranged to burn with either one colour or two or more colours in succession. A considerable number and variety of signals can be produced by making full use of the various combinations thus available. For example, the White Star burn a green light at bow and stern; the Cunard Line, off the Irish coast, burn a blue light followed by two golden star rockets; and the Ulster Steamship Company fire three vertical lights, yellow, blue and red, followed by two Roman candles together, each throwing two yellow, two blue and two red stars.

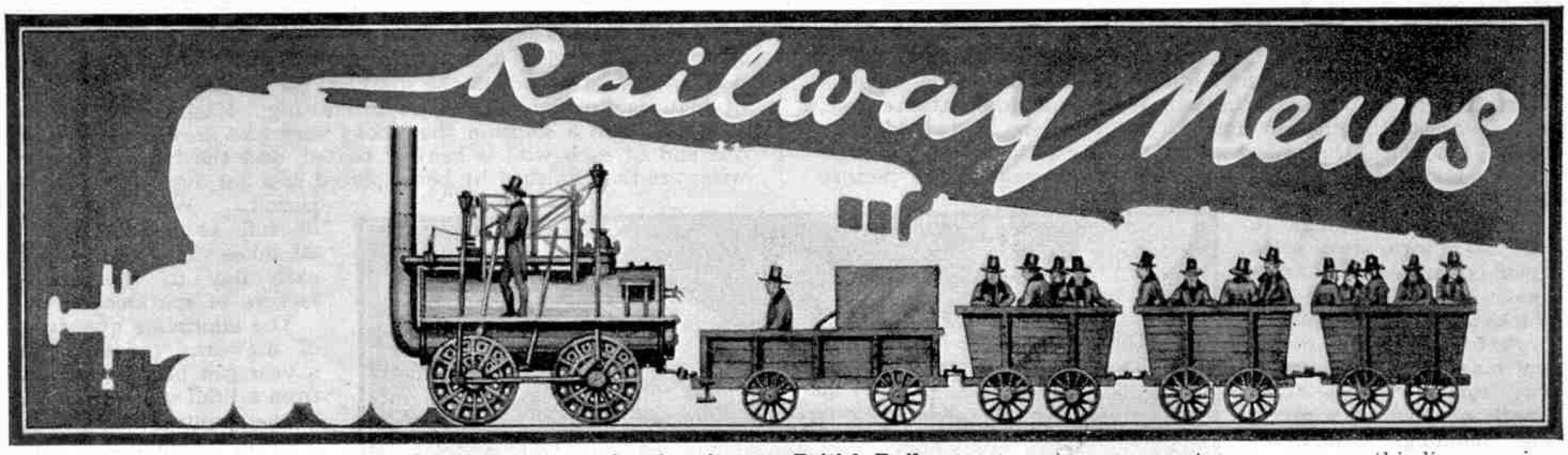


Rolling the cases for fireworks in the Standard Factory at Huddersfield.

Light signals are used also to communicate between vessels of the fishing fleets, and with the carriers, and they are employed also to a great extent by the coastguard and at harbours and ports. Then there is the life-line-carrying rocket that has resulted in the saving of thousands of lives from wrecked vessels. The idea of a rocket of this nature was put forward in 1807 by a Cornishman named Trengouse, but it was not until 1855 that the line-carrying rocket, in a greatly improved form, came into general use. At first such rockets were used entirely for carrying a line from shore to ship, but more recently rocket apparatus has been developed to enable a wrecked ship to fire a line to the shore. Wrecks usually take place when the wind is blowing onshore, and therefore a rocket fired from a ship travels with the wind and has a much better chance of reaching its destination than one fired in the opposite direction.

Fireworks are used also to a great extent in the form of maroons to provide sound signals. Maroons giving warning of air raids became unpleasantly familiar in London during the Great War.

The use of fireworks on active service during the Great War was of much greater importance than is generally realised. There was, for instance, the smoke screen brought to perfection by Wing-Commander F. A. Brock, R.N.A.S., who was killed at Zeebrugge on 23rd April, 1918. Commander Brock also devised the anti-zeppelin bullet that proved such an effective check on the zeppelin raids, and the million candle power Dover flares used in hundreds every night by the anti-submarine patrol in the Straits of Dover.



"*Cheltenham Flyer's*" Record Speed

The Great Western Railway's "*Cheltenham Flyer*"—the world's fastest train—has again been accelerated and as foreshadowed in the "*M.M.*" for August, its new schedule requires a speed of over 70 m.p.h., start to stop. Commencing on Monday, 12th September, the running time for the 77¼ miles from Swindon to Paddington was reduced from 67 to 65 minutes, thus raising the average speed from 69.18 to 71.3 m.p.h.

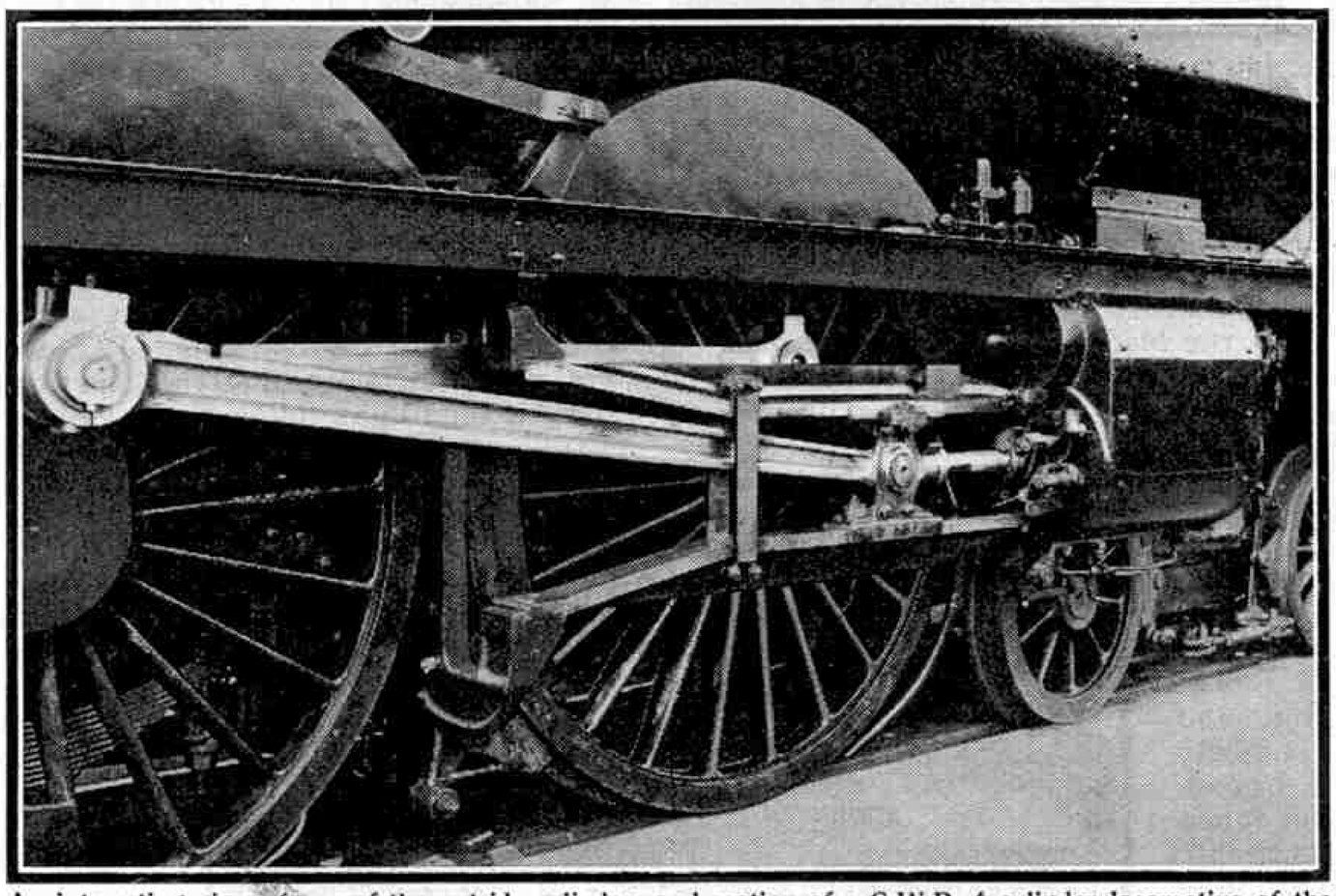
The G.W.R. can proudly claim that this is the first time in the hundred years of the world's railway history that a train has been regularly scheduled at 70 m.p.h., or over. The cut of two minutes was made by deducting half a minute from the former running times allowed between Swindon and Steventon; Didcot and Reading; Reading and Slough; and Southall and Paddington respectively.

Apart from the occasions when special runs have been made and records achieved, the ordinary working of the "*Cheltenham Flyer*" from day to day during the past months has shown that the new accelerated schedule was well within the power of the "Castles." On Tuesday, 6th September, for instance, engine No. 5016, "*Montgomery Castle,*" one of the newest batch, in charge of Driver J. W. Street and Fireman F. W. Sherer, with a train of seven coaches weighing 230 tons, arrived at Paddington six minutes early, in spite of a long slack to 10 m.p.h. at Didcot and signal checks at Reading and Acton. Perhaps the most meritorious run ever made by this celebrated train was on Whit Tuesday, 17th May last, when with a heavy load of 11 crowded coaches, weighing fully 360 tons, the 77¼ miles were covered in 62 minutes, so that even with such an exceptional load, the present new schedule was improved upon by three minutes. This latter feat also stands to the credit of Street and Sherer with engine No. 5006 "*Tregenna Castle.*"

On Monday, 12th September, when the new timing came into force, Driver T. Lewis and Fireman W. White with engine No. 5016, "*Montgomery Castle,*" and a train of eight coaches weighing 265 tons made the run in 61 min. 8 sec. The average speed was almost 76 m.p.h.

Accelerations on British Railways

In the winter time-tables of the L.M.S.R., which came into force on 12th September, more than 1,000 passenger trains have been accelerated. Following on the improved services introduced in May and July, this means that during the present year the L.M.S.R. have accelerated a total of 3,101 passenger trains so as to cut running times by 10,084 minutes—representing a saving in travel time of 168 hours per day.



An interesting view of one of the outside cylinders and motion of a G.W.R. 4-cylinder locomotive of the "Abbey" series. The characteristic form of the slide bars is plainly shewn, their outer ends being arranged to clear the connecting rods, which have solid-eye big ends with circular bushes.

The latest accelerations cover a wide field, ranging from important business trains between London, Manchester, Liverpool and winter health resorts, to local services in the London and principal provincial areas, and many cross-country trains. Between London and Manchester there are now three trains—two up and one down—booked to make the journey in 3¼ hours. One of these has been named "*The Comet,*" and leaving Manchester at 5.40 p.m., it is timed to run the 133 miles from Stafford to Euston in 127 minutes at an average speed of 63.1 m.p.h. Another new booking at over a mile a minute is the run of the down "*Lancastrian*" (6.0 p.m. from Euston) which does the 177 miles from Euston to Wilmslow in 176 minutes, an average of 60.3 m.p.h.

On the Midland route between Manchester and London (St. Pancras) six expresses have been speeded-up, while 11 trains between Euston and Liverpool are altogether 114 minutes faster each day compared with a year ago.

The L.N.E.R. has also added to its accelerations in its winter services. There are now six expresses on this line running at average start-to-stop speeds of 60 m.p.h. or over, the fastest being the run from Grantham to King's Cross, 105½ miles in 100 minutes, giving an average of 63.3 m.p.h. On the East Coast main line the 8 a.m. from Newcastle and the 2.5 p.m. express from Edinburgh (which is provided with radio-gramophone equipment) now arrive at King's Cross 21 minutes and 10 minutes earlier than previously.

On the G.W.R., in addition to the brilliant run of the "*Cheltenham Flyer,*" there are 11 other trains performing start-to-stop journeys at speeds of 60 m.p.h. or more, and a further 46 at speeds of 55 m.p.h. and over.

The winter time-tables of the S.R. show numerous revisions. The popular "*Bournemouth Belle*" Pullman train, which ran daily during the summer, continues to run on Sundays only throughout the winter. A noteworthy improvement is the introduction of a 15-minute service of electric trains on the Dartford Loop Line in the non-business hours and on Sundays. This means that no less than 249 additional trains a week will be provided, for there will be 33 extra trains each weekday and 51 additional services on Sundays.

London "Underground" Developments

The great three years' programme of extensions and improvements which the London Underground Electric Railways are carrying out at a cost of £11,000,000, is now rapidly maturing and some of the most important works have already been completed. The first section of the Cockfosters extension of the Piccadilly Railway from Finsbury Park to Arnos Grove was opened for traffic on 19th September. Stations have been built at Manor House, Turnpike Lane, Wood Green, Bounds Green and Arnos Grove. The remainder of the new line will be opened next year.

The reconstructed station at Marble Arch has been completed and brought into use. It has been thoroughly modernised in a style similar to the station at Piccadilly Circus but on a smaller scale. The old lifts have been superseded by escalators which are speedy, yet quiet, in action.

Fast Runs by L.M.S.R. "Baby Scots"

An order for some additional standard 3-cylinder 4–4–0 compound express locomotives is now in hand at Derby Works and the first two of the new batch—Nos. 935 and 936—are already in service. They have both been noted at Birmingham recently, having worked there from Derby. Mr. Stanier has introduced several alterations in the details of these new engines as compared with the earlier ones of the class, and, like the latest tanks and 0–8–0 engines, they have round-headed rivets in some places where countersunk ones formerly were used.

Another 2–6–4 tank engine has been completed at Derby and is working in the Central Division. It is numbered 2383.

The latest "Baby Scots" (reconstructed "Claughtons") in service are Nos. 5949 and 6010. Nos. 6010 and 5974 are stationed at Camden shed; Nos. 5949, 5959, 5985 and 5987 are at Manchester (Longsight). The Longsight "Baby Scots" are sharing with "Royal Scots" the working of the fastest expresses between Manchester and London. No. 5959 was the first to be tried on the accelerated up "*Mancunian*" and with a load of 300 tons arrived at Euston one minute early, having run the 177 miles from Wilmslow in 171 minutes. The fastest run made as yet by the "*Mancunian*" was on 23rd August when, with "Royal Scot" engine No. 6134, "*Atlas*," and a train of 300 tons, Driver Cobb and Fireman Lapham, of Camden shed, reached Euston eight minutes early, having averaged 64.75 m.p.h. from Wilmslow. A check was experienced at Lichfield and from there to Euston the average speed was 69.75 m.p.h.

It is stated on good authority that when certain bridges have been strengthened, "Baby Scots" will be employed on the Derby, Birmingham and Bristol section of the Midland Division.

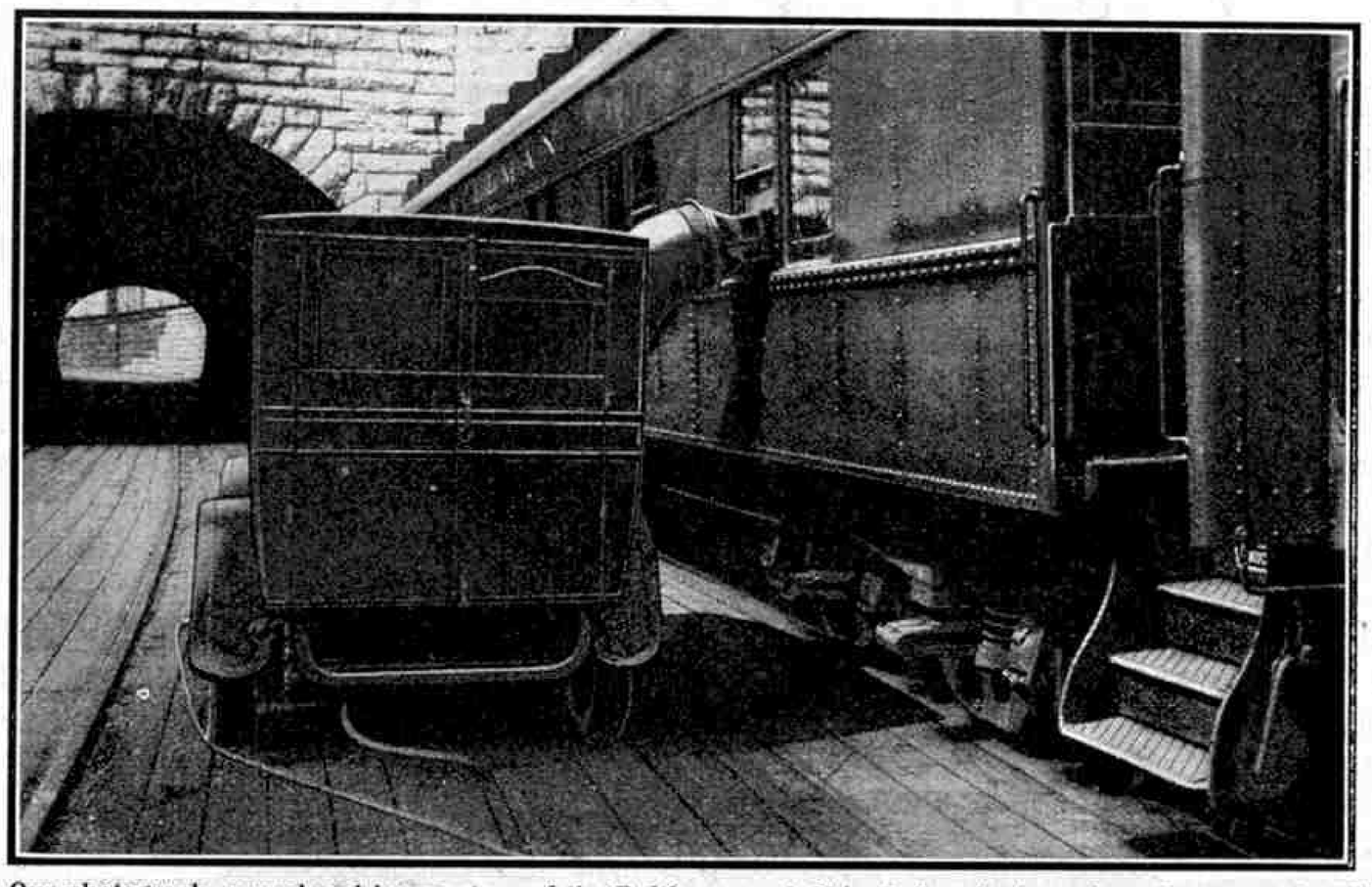
An order has been placed for five small 0–4–0 shunting engines. They will have saddle-tanks and a short wheel base to fit them for working in yards where there are sharp curves.

2-8-0 Goods Engines for L.N.E.R.

Four more of the standard 3-cylinder 2–8–0 standard freight locomotives have been turned out from the works at Doncaster and are numbered from 2958 to 2961. These complete the order for eight engines of this class, all of which are working heavy freight trains on the former G.E.R. section, chiefly between March (Whitemoor Marshalling Yard) and Stratford.

The Passing of the "Gladstones"

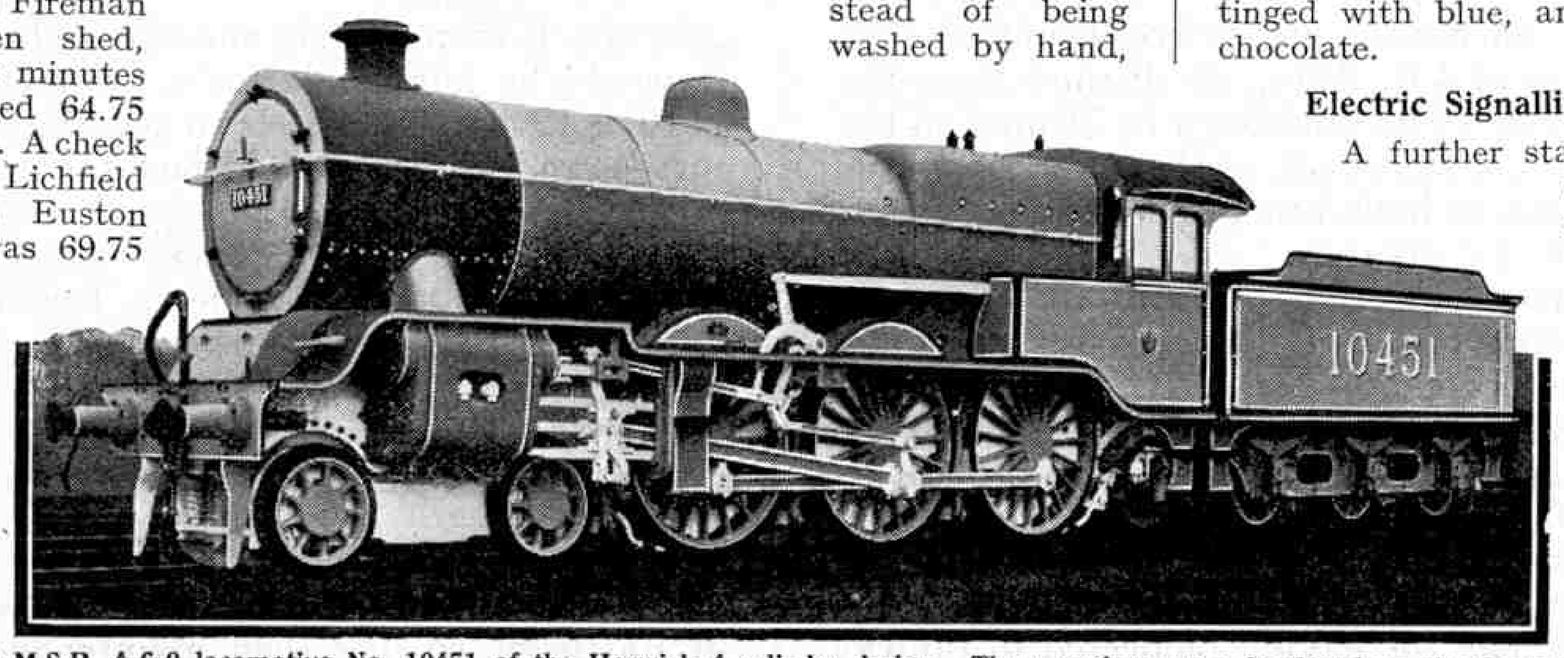
The S.R. 0–4–2 express locomotive No. 197 of the L.B.S.C.R. "Gladstone" class was withdrawn for scrapping at the end of August. It was built in 1888 and received the name "*Jonas Levy.*" It continued in active service right up to the end, putting in almost every day the full round of duties described in the "*M.M.*" for June last. Of the 36 engines which comprised this famous class, only one—No. 172—now remains at work. It is stationed at Brighton.



Our photograph, reproduced by courtesy of the Baltimore and Ohio Railroad, shews how the atmosphere of a sleeping car on that line is cooled before a night run. The motor vehicle houses a fan that draws in air across ice cakes and discharges it through a metal duct into the sleeping car, the warm air passing out through the overhead ventilators.

Shower Baths for Locomotives

A novel method of washing locomotives has been adopted by the Canadian National Railways. Instead of being washed by hand, the engines are passed through and under a hoop-like washing frame fitted with spray nozzles. As this is reached, the front wheels of the engine close an electrical circuit that turns on hot water sprays having a pressure of 140 pounds to the square inch. When the engine and tender have slowly passed through the frame the rear wheels break the circuit and the water flow ceases. A cleaning compound mixed with the spraying water dissolves oil and grease and leaves on the washed surface a film of wax which renovates the paintwork and discourages rust.



L.M.S.R. 4-6-0 locomotive No. 10451 of the Horwich 4-cylinder design. These engines were developed on the former Lancashire and Yorkshire Railway, and with the "Claughtons" formed the chief express locomotives in the Western Division of the L.M.S.R. before the introduction of the "Royal Scots."

G.W.R. Locomotive News

The new engines at present building at Swindon are all of standard tank types. Ten 0–6–0 tanks, numbered 5800-9, should be ready for service early this month and ten more of the same class will follow later. These engines will not be fitted with the automatic signalling apparatus or the gear for working auto trains. A start has been made on 20 2–6–2 tank engines similar in all respects to the "6100" class recently built. They will be numbered from 6130 to 6149 and the first will probably be in traffic by the end of this month.

Straight outside admission steam pipes, similar to those on engines of the "Hall" class, have been fitted to 12 2-cylinder 4–6–0 engines of the "2900" class, and two more 4–6–0 express locomotives of the "Star" class—No. 4038, "*Queen Berengaria,*" and No. 4048, "*Princess Victoria*"—have been fitted with outside steam pipes like those on No. 4002.

L.M.S. Royal Train

In readiness for the King's journey to Ballater and back in connection with his usual summer visit to Balmoral, the L.M.S.R. Royal train was recently repainted and thoroughly renovated. It is said that the L.M.S.R. authorities had proposed to repaint it in their standard deep-red colour but in deference to the King's own wish it was done again in the former L.N.W.R. colours, the upper panels being white, tinged with blue, and the lower a dark chocolate.

Electric Signalling on L.M.S.R.

A further stage of the automatic electric colour-light signalling which is being introduced by the L.M.S.R. between Camden and Watford, with a view to increasing and accelerating the electric train services on this section of the line, was brought into operation on 4th September, when the new system of signalling was extended from Willesden to Kilburn, leaving the sections from Hatch End to Watford and from Kilburn to Camden to be converted later in the year.

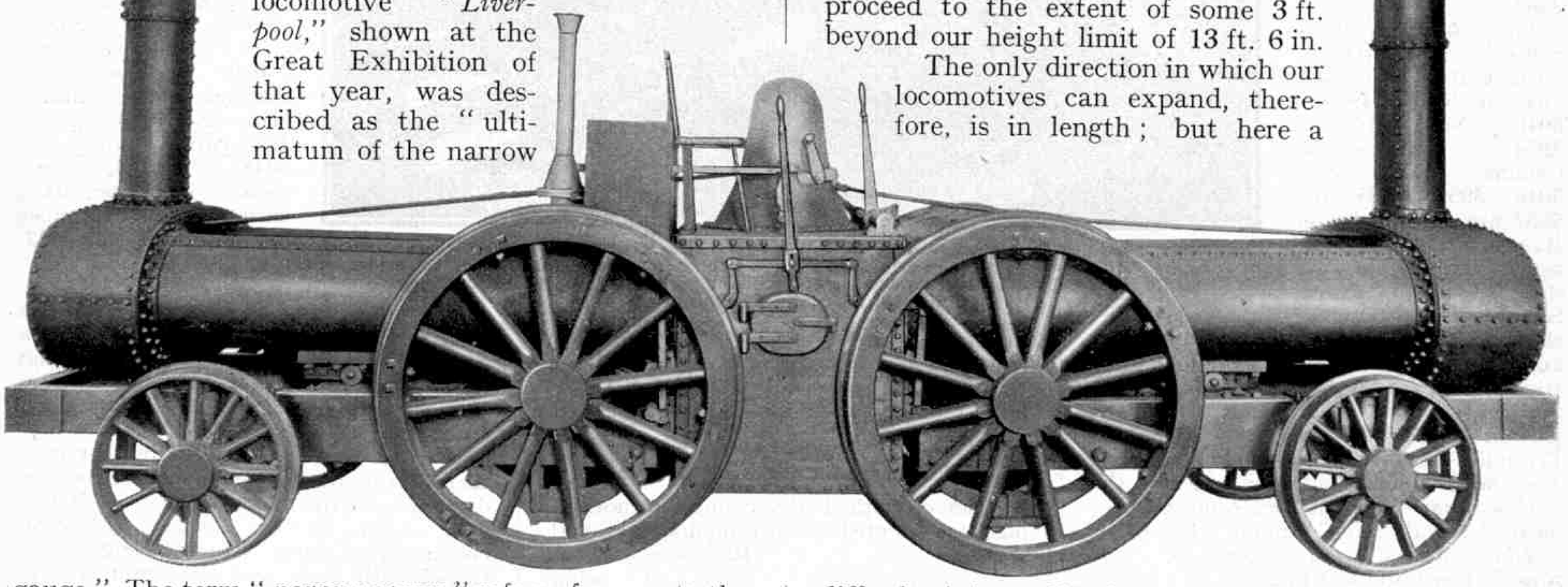
A Boon for Rail Travellers

As a result of the Pooling Scheme that has been adopted by the L.N.E.R. and L.M.S.R. passengers between any two points served by both companies can use their return tickets (except excursions) by any direct route. For example, passengers who have travelled from King's Cross to Edinburgh by "*The Flying Scotsman*" may return to Euston by "*The Royal Scot.*"

The Story of the Flexible Locomotive

I.—Solving the Curve Problem

THE history of the steam locomotive shows an almost continuous expansion in size and power, yet the appearance of a new locomotive larger than any of its predecessors has usually called forth opinions that development had reached its maximum. This was the case as long ago as 1851 when the Crampton locomotive "*Liverpool*," shown at the Great Exhibition of that year, was described as the "ultimatum of the narrow gauge." The term "narrow gauge" refers of course to the now standard gauge of 4 ft. 8½ in., as distinct from the "broad gauge" of 7 ft. 0¼ in. laid down by Brunel on the G.W.R. Since that time, however, as the strength of rails has increased and tracks have become better laid, it has been found possible for greater weights to be carried by the permanent way, and the size and weight of the locomotive have steadily increased.

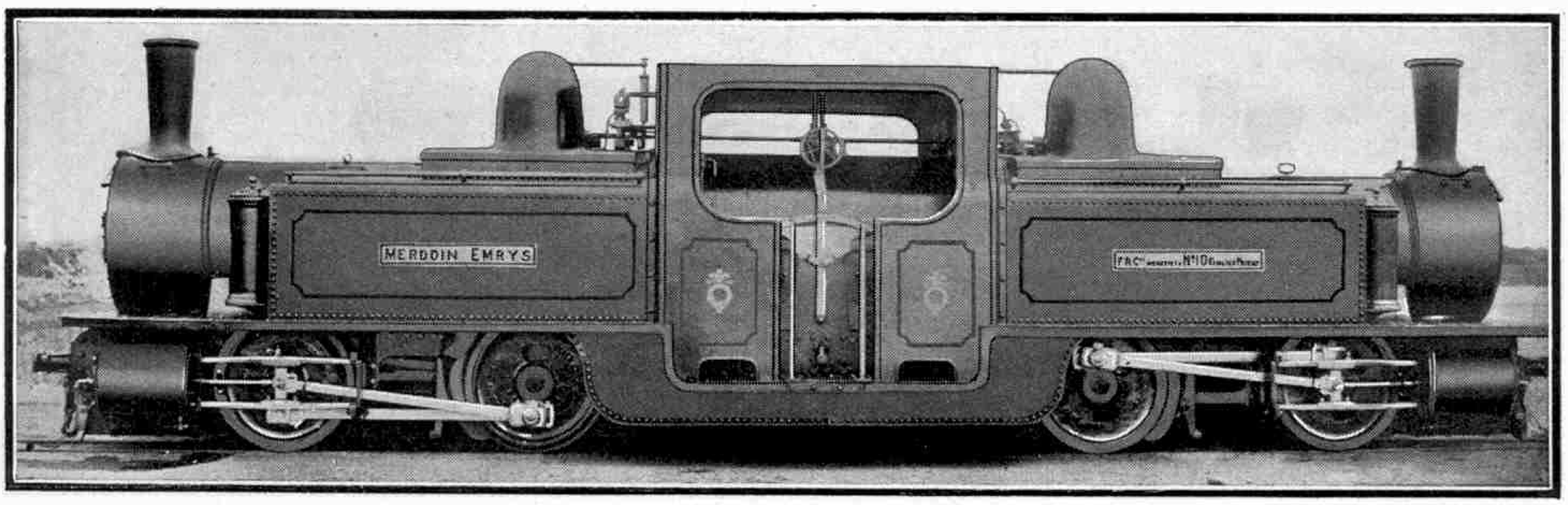


The "South Carolina," an early attempt at an articulated locomotive. It was built in 1832 to the designs of Horatio Allen, a famous American locomotive pioneer. Photograph by courtesy of the Baltimore and Ohio Railroad.

British railways are now faced with the serious fact that the limits in height and width permitted by the standard loading gauge have now been reached. This is the penalty we have to pay for having pioneered in railway construction. In the early days of our railways no one could foresee the enormous development that would take place, and as a result bridges and tunnels were constructed on a scale that was in keeping with the small locomotives of the time. In many cases the difficulty has been overcome in recent years by opening out the early structures and by replacing old underbridges by new ones capable of carrying heavier loads. In order to attain any great increase in the possible width of locomotives, however, station platforms would have to be altered, and possibly the "six-foot way" between up and down tracks would have to be increased. The cost involved in such tremendous alterations makes their accomplishment out of the question. In America and on the Continent, where loading gauge dimensions are more liberal, considerably larger engines have been built than those we have in use in this country, although the track gauge is the same. Now, however, even American designers seem to be unable to move further in the matter of height and width, although they may proceed to the extent of some 3 ft. beyond our height limit of 13 ft. 6 in.

The only direction in which our locomotives can expand, therefore, is in length; but here a difficulty is immediately encountered in regard to curves. It would be impossible for a locomotive with as many as 10 or 12 coupled wheels to negotiate any but very easy curves, and as a matter of fact there are certain restrictions on even our six-coupled express locomotives. There are many sections of line in England that can only be worked by light tank engines with very short rigid wheelbases. Thus the S.R. still maintain three antique tank locomotives of a design dating from 1863 for use in North Cornwall. One of these pigmies has recently been overhauled and fitted with new cylinders at Eastleigh, so that their maintenance in service seems likely for some time to come. Their diminutive proportions render them suitable for service on the Wensford Branch, where much china clay traffic is dealt with. The curves and light construction of the line make a moderate weight and short wheelbase essential in the engines working over it.

In some cases, in order to work trains where curves are very sharp, and at the same time traffic is heavy, engineers have designed locomotives with many driving wheels, several pairs of which are without flanges. This plan of flangeless driving wheels is quite practicable, but it cannot be applied to more than a small proportion of wheels, otherwise the engines would become unsafe for running at high speeds. Then there are numerous



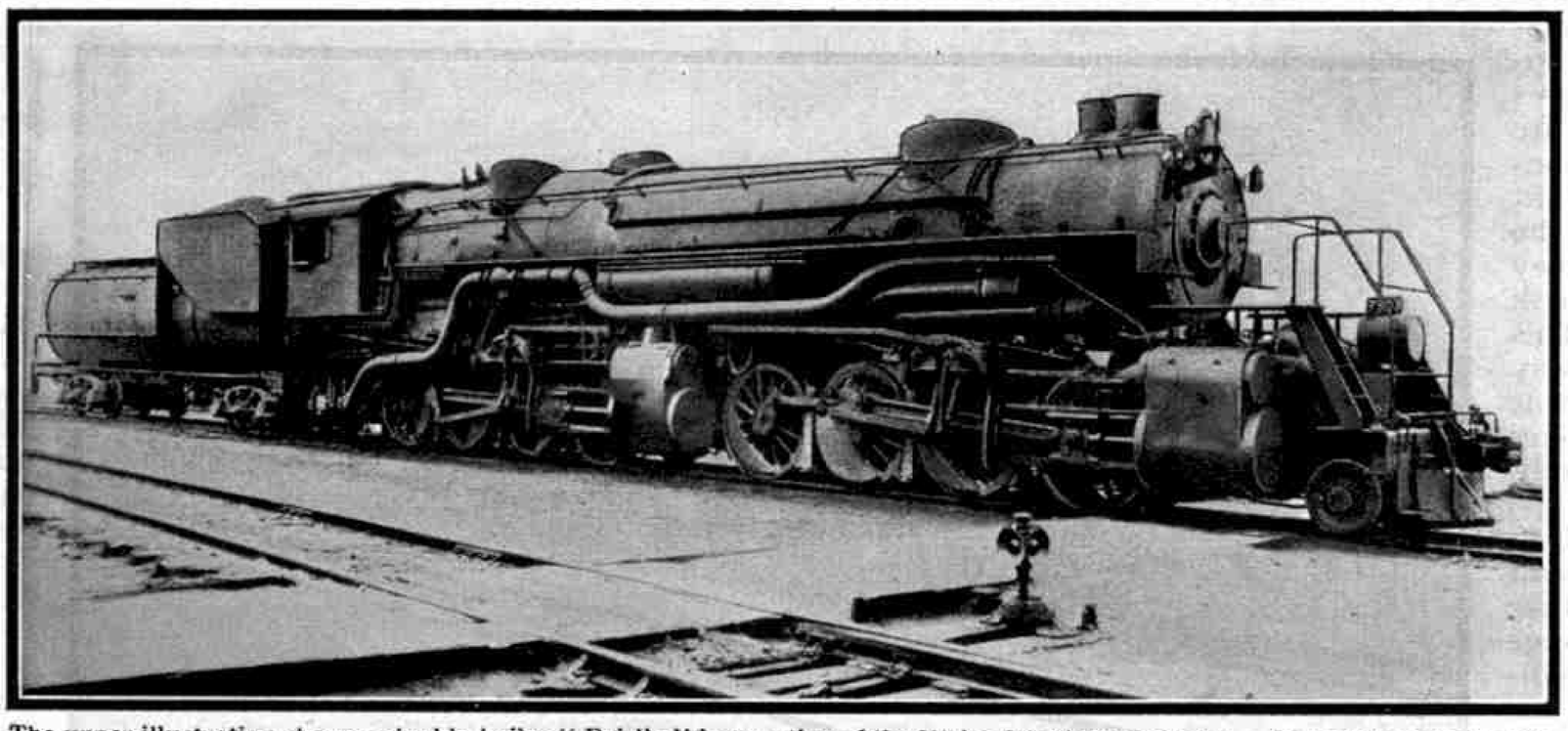
systems for giving a certain amount of lateral play to the wheels on curves. These are satisfactory to a certain extent, but there are obviously limits to the amount of play that can be tolerated, because of the oscillation set up at speed on a straight track.

Another method open to the locomotive designer is to employ the swivelling bogie principle. This has been utilised wherever expansion of locomotives has been absolutely necessary, and where at the same time the limits of the loading gauge have been reached. The application of the principle may be made on one or other of the systems of articulation that have been devised. Many articulated locomotives work in a similar manner to an ordinary bogie coach. The boiler may be looked upon as the coach body running on two bogies that are fitted with cylinders to make two separate locomotives or power units. As in the case of the bogies of coaches, these separate driving units are constructed so that they follow the curve of the rails. In this manner a locomotive twice the normal length can negotiate an ordinary curve without difficulty, and with perfect safety.

There are many designs of articulated locomotives, the best known being the "Fairlie," the "Mallet," the "Kitson-Meyer" and the "Garratt." The "Fairlie" locomotive was designed and patented in 1864 by Mr. R. F. Fairlie, a British engineer, although a very early attempt at a similar design is shown by the "*South Carolina*" of 1832, for which the American, Horatio Allen, was responsible. The principle of the "Fairlie" is that of two boilers having one common fire-box. In other words, it is to all intents and purposes two completely separate engines back to back, with the fire-box between. The fire-box door is necessarily placed at one side where the fireman stands, and the driver controls the operation of the locomotive from the other.

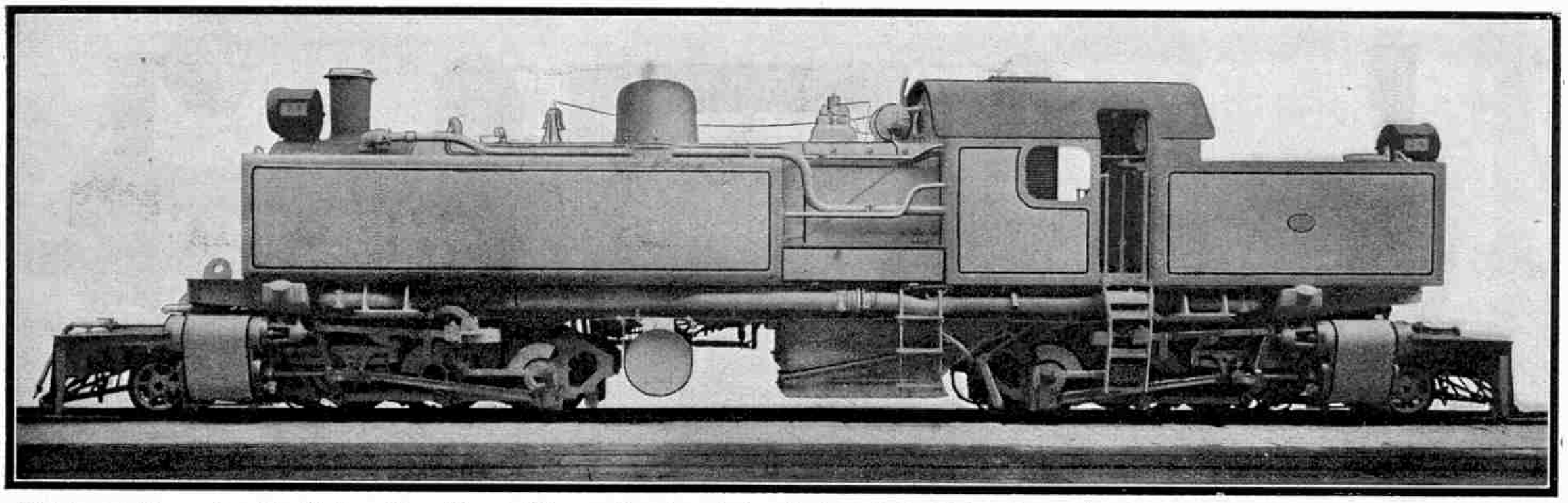
In these respects, then, the "*South Carolina*" anticipated the "Fairlie," and was further remarkable for having two boiler barrels between each smoke-box and the common fire-box. There was thus a total of four barrels. Two cylinders, one at each end, were situated on the centre line of the engine, and both exhausted into tall chimneys at each end. Thus, although Fairlie was responsible for what was perhaps the first successful application of the plan, the "*South Carolina*" was certainly an early step in the same direction.

An example of a "Fairlie" locomotive in this country is shown in one of the accompanying photographs. This locomotive belongs to the Festiniog line of the Welsh Highland Railway. It will be seen that it has two sets of coupled wheels, and these swivel in a similar manner to those of a railway coach. The appearance of the engine strongly suggests that it is trying to travel in both directions at once! This is beyond its powers, but it can travel equally well in either direction and is therefore very convenient for single-track working. The boiler is much larger than could otherwise be possible, and the more even weight distribution resulting from the wheel movement enables the locomotive to operate on a lightly-laid track.



The upper illustration shows a double-boiler "Fairlie" locomotive of the Welsh Highland Railway. The driving wheels are mounted in steam-driven bogies, and allow the engine to take sharp curves easily. In the lower picture appears an American locomotive of the "Mallet" compound articulated type. The high-pressure cylinders drive the rear set of coupled wheels, and the leading set mounted in a pivoted truck are worked by the low-pressure cylinders.

An interesting story is often told of an episode concerning a Mexican "Fairlie," which serves as a striking illustration of the exceptional ability of these engines to keep to the rails, however sharp the curves may be. The Orizaba Incline on the Mexican Railway is a long and difficult climb extending over 30 miles. One day a "Fairlie" locomotive was shunted into a siding after assisting a train to climb the bank. The enginemen dropped off in order to snatch a hasty meal, but owing to the brakes having been carelessly adjusted the engine commenced to move backward, but so silently as to be



A 2-6-0 : 0-6-2 locomotive of the " Kitson-Meyer " type. This resembles a large tank engine in which the driving units are pivoted so that they can partially rotate, their movement being similar to the bogies of an ordinary coach.

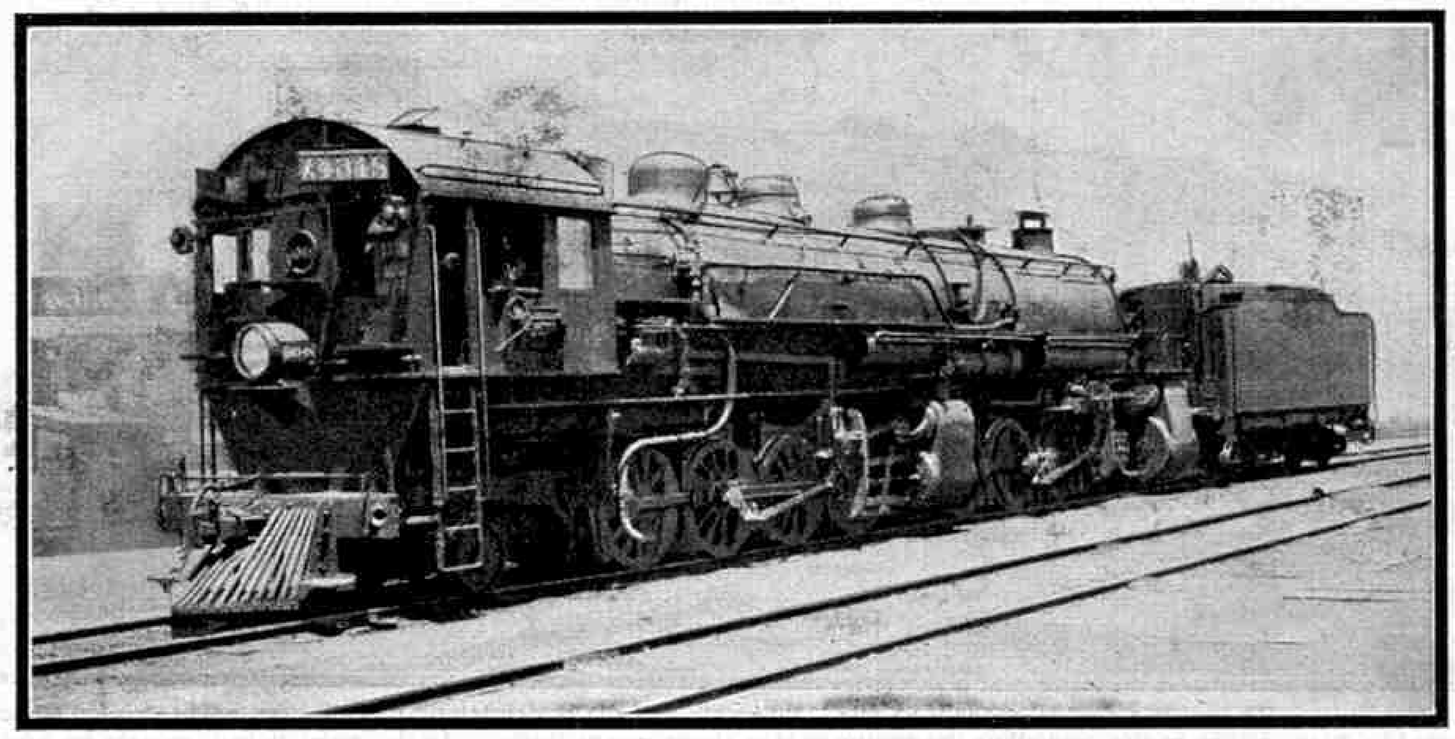
unnoticed by the crew. It was only when they heard something jolting over the points of the siding that they realised what had happened. Pursuit was out of the question, so a frantic message was flashed by telegraph to give a clear course to the runaway, although it was considered fairly certain that it would leap over the edge of a precipice at one or other of the difficult bends on the line and be smashed to pieces. One can imagine, therefore, the amazement of everybody concerned when it was found that the locomotive had come quietly to a standstill 30 miles farther down the Incline, without having received the slightest damage. The distance had been covered in well under half-an-hour, and the fact that the engine kept the rails is a striking tribute to the flexibility of the " Fairlie " arrangement.

The Festiniog engine, which is described as being of the 0–4–0 : 0–4–0 type, is practically an 0–8–0 broken in halves, but owing to the flexibility of the " Fairlie " design it can traverse curves that would be absolutely impossible for an engine of the ordinary 0–8–0 type. The dis-

advantage of such engines is that the driver and the fireman are separated by the common fire-box, and that in the event of the engine overturning they run considerable risk of being crushed. This difficulty is done away with if two independent boilers and fire-boxes are used, and this modification of the "Fairlie" design was effected in 1902 by the Vulcan Foundry. A further advantage of this change is that on steep gradients the variation in water level is not so great.

The use of separate boilers had been introduced in 1885 in some engines built by the then Rhode Island Locomotive Works. These were known as " Johnstone " locomotives after their originator. Although swivelling bogies were employed the cylinders, unlike those of a " Fairlie," were attached to the main frames, and the motion was thus necessarily complicated. As a result of this construction the steam did not have to pass through any articulated joints, but this advantage was outweighed by the inconvenience resulting from the complication of the valve gear. A further modification is seen in the single-boilered " Fairlie " engine, for although the double boiler was one of the features of the original design it was not an essential one, and Fairlie himself had built a locomotive having only one boiler. This development will be considered after the " Garratt " design, to which it is somewhat similar.

Another interesting type of articulated locomotive is the " Mallet," which takes its name from Anatole Mallet, whose locomotives on the Bayonne-Biarritz Railway were the first in which the principle was embodied successfully. Only one boiler is used, and this is carried on two driving units. The rear unit is an integral part of the locomotive, in the same way as the driving wheels of an ordinary 4–4–0 ; but the front unit is able to move laterally like a huge pony truck. Its centre of rotation is located between the centres of the cylinders in front of the rear driving wheels. Owing to its movement in this manner special arrangements are necessary to support the boiler on curves, and this is effected by a special bearing saddle or saddles, which may have spring gear, in order to keep the boiler central when the engine regains the straight track. The most important feature of any locomotive is a boiler with good steaming properties, and the great length of the " Mallet " allows plenty of room for the fitting of a boiler of ample capacity.



A " Maliet " locomotive of unusual design running on the Southern Pacific Railroad. It is run cab foremost, the tender being at the chimney end as the engine uses oil fuel, and the driver therefore has a very good look-out ahead, for there is no smoke or steam to obscure his view.

The " Mallet " has become extremely popular throughout Europe and the United States. It is a type of locomotive particularly well adapted to the tremendously heavy freight services that are involved by the use of high-capacity wagons in America. On one occasion, on the Virginian Railways, a coal train of 111 wagons having a total weight of 15,400 tons was worked by a " Mallet " locomotive of the 2–10–0 : 0–10–2 type. This vast train was hauled unassisted over a distance of 130 miles, and this fact shows the tremendous power that can be developed by such engines.

The " Mallet " system of articulated locomotive is the only one where the double expansion of steam, or compound working, has been successfully applied. The high-pressure pair of cylinders are located on the rear driving unit, and as this is rigidly attached to the boiler, steam at boiler pressure has no flexible joints to pass through that are likely to cause trouble. To this point a great deal of the success of compound working in " Mallet " designs is due. The low-pressure cylinders are attached to the leading pivoted driving unit, and as the steam passing through them is at a much lower pressure than boiler steam, no trouble is occasioned with the flexible joints through which it must pass.

On the Chesapeake and Ohio Railroad the existing 2–6–0 : 0–6–2 " Mallet " compounds had to be supplanted by something more powerful. The 2–8–0 : 0–8–2 engines that were built were provided with four cylinders, all taking steam at boiler pressure, since low-pressure cylinders of the diameter necessary for the required power output could not be accommodated owing to the restricted width of a certain tunnel in the Allegheny Mountains. These particular locomotives were built so as practically to fill the loading gauge. As a result of their performances a number of earlier 2–6–0 : 0–6–2 " Mallets " were converted to simple engines with four high-pressure cylinders.

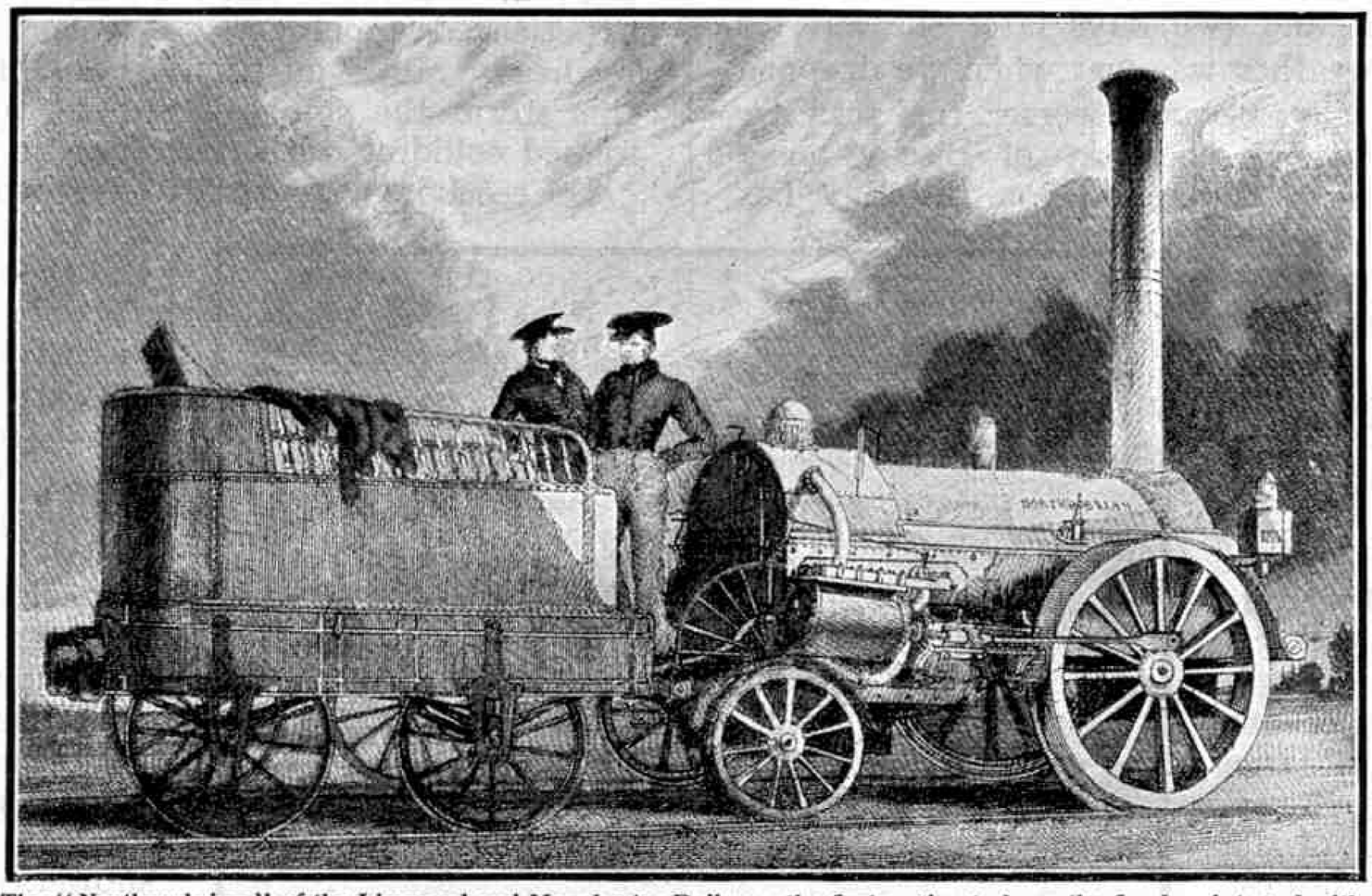
Several attempts had been made to operate single-expansion " Mallets " in earlier times, but various difficulties were met with, such as trouble in the passage of high-pressure steam through flexible joints, and the fact that the boiler capacity was then hardly sufficient to fill four cylinders at once.

(Continued on page 770)

Locomotives of a Century Ago

Features of Design that are still in Use

WE have become so accustomed to the general features and outlines of up-to-date locomotives that when we see a design of only a few years ago we are apt to dismiss it as practically obsolete. A far greater difference, therefore, appears to exist between locomotives of a hundred years ago and those of to-day. A casual inspection of the illustrations on this page will appear to confirm this, but closer examination will show several interesting points in the design of the old engines that are not very far removed from the practice of the present day. The external differences in appearance are of course considerable, but there are various features now common to locomotive practice that appeared for the first time, or nearly so, in one or other of the engines illustrated.



The "Northumbrian" of the Liverpool and Manchester Railway, the first engine to have the fire-box integral with the boiler and a tender of orthodox design.

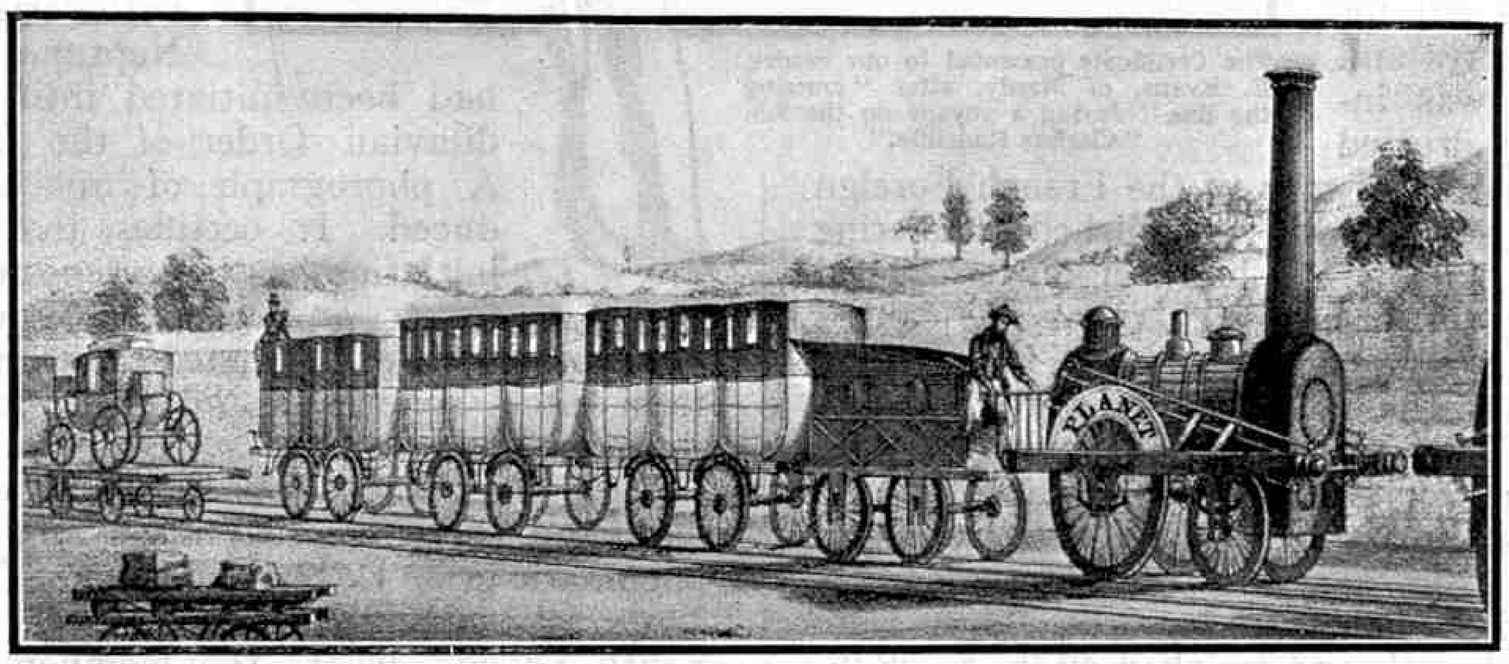
After the "*Rocket*" had shown in the Rainhill Trials of 1829 that the future of the steam locomotive was assured, further engines of similar general design were built in view of the opening of the Liverpool and Manchester Railway in the following year. Among these was the "*Northumbrian*" illustrated on this page, and it differed from the original design of the "*Rocket*" in several respects. It had been found that the somewhat steeply-inclined cylinders made the "*Rocket*" unsteady at the comparatively high speeds for that time that had been reached, so that the succeeding engines had the cylinders in the position shown in the illustration referred to. Here they were more nearly horizontal, although still placed outside and at the fire-box end.

The fire-box itself on the "*Rocket*," it will be remembered, was separate from the boiler barrel and not enclosed within the boiler structure; and the "*Northumbrian*" was the first engine to have the fire-box integral with the boiler. This design of fire-box is the one that has survived to the present day, and it is remarkable that practically the only alteration has been the addition of the brick arch, the use of which was unknown in the early days when coke was the fuel. Many designs of more or less complicated character were evolved in later years in the attempt to secure the satisfactory combustion of coal without smoke, but these have all disappeared in favour of the simpler form originated in the "*Northumbrian*."

The normal design of smoke-box, as later fitted to the "*Rocket*," was also provided, and this was one of the earliest instances of its application, the first locomotive so fitted being a sister engine named "*Phœnix*." The "*Northumbrian*," too, was the first to have a tender that was worthy of the name, for previous tenders had been of the wagon-and-water-cask variety made familiar by early prints. The necessity for buffing apparatus had evidently made itself felt, for a single central buffer of primitive appearance is shown on the rear of the tender.

The engine was used at the opening of the Liverpool and Manchester Railway on 15th September, 1830, George Stephenson himself driving it. It headed the first of the eight trains that left Liverpool for Manchester, the Duke of Wellington being a passenger on this particular one. After the unfortunate accident to Mr. Huskisson at Parkside, the "*Northumbrian*" was used to take him to Eccles for attention. The engine was numbered "eight" in the company's books, and remained in use until 1836.

Two months after this engine had appeared the "*Planet*" was built, and this may be said to be the starting point in the design of the steam locomotive as understood to-day. It was a considerable advance upon any previous engines, and Robert Stephenson must take the credit for the design. In this the boiler was supported by the frames, and the cylinders were placed horizontally and at the front end of the engine under the smoke-box. Owing to this inside position of the cylinders, the driving axle was of the cranked variety placed in front of the fire-box, which was of the square pattern as used to-day, and made integrally with the multi-tubular boiler. The "*Planet*" was evidently one of the crack engines of the day, for it was used on a special train conveying voters from Manchester to Liverpool for an election. Including a stop of two minutes for water, the distance was covered in an hour.



The "Planet" locomotive, in which the boiler and fire-box, smoke-box, inside cylinders and crank axle as used to-day were applied together for the first time.

The advantages of the design were quickly apparent and further engines of the class were built. In the following year, in order to obtain greater adhesion, the "Samson" class was introduced, in which 4-coupled wheels were employed, the general design remaining the same.

Enlargement of the general features with the object of increasing the power necessitated further support in the shape of another pair of wheels behind the fire-box, thus making the 2–2–2 the accepted engine for passenger traffic, and

(*Continued on page 770*)

FROM OUR READERS

These pages are reserved for articles from our readers. Contributions not exceeding 500 words in length are invited on any subject of general interest. These should be written neatly on one side of the paper only, and they may be accompanied by photographs or sketches for use as illustrations. Articles that are published will be paid for at our usual rates. Statements contained in articles submitted for these pages are accepted as being sent in good faith, but the Editor takes no responsibility for their accuracy.

My Meeting with Father Neptune

I went to sea early last year in the S.S. "*Clarissa Radcliffe.*" When I joined her the vessel was loading coal in Barry Docks, and two days later she left for Spezia, Italy. The weather was wet when we dropped the pilot and gradually became worse, the seas we encountered when crossing the Bay of Biscay being heavy enough to justify the reputation the Bay has earned. Fortunately we had fine weather on passing down the coasts of Portugal and Spain and along the African shores of the Mediterranean.

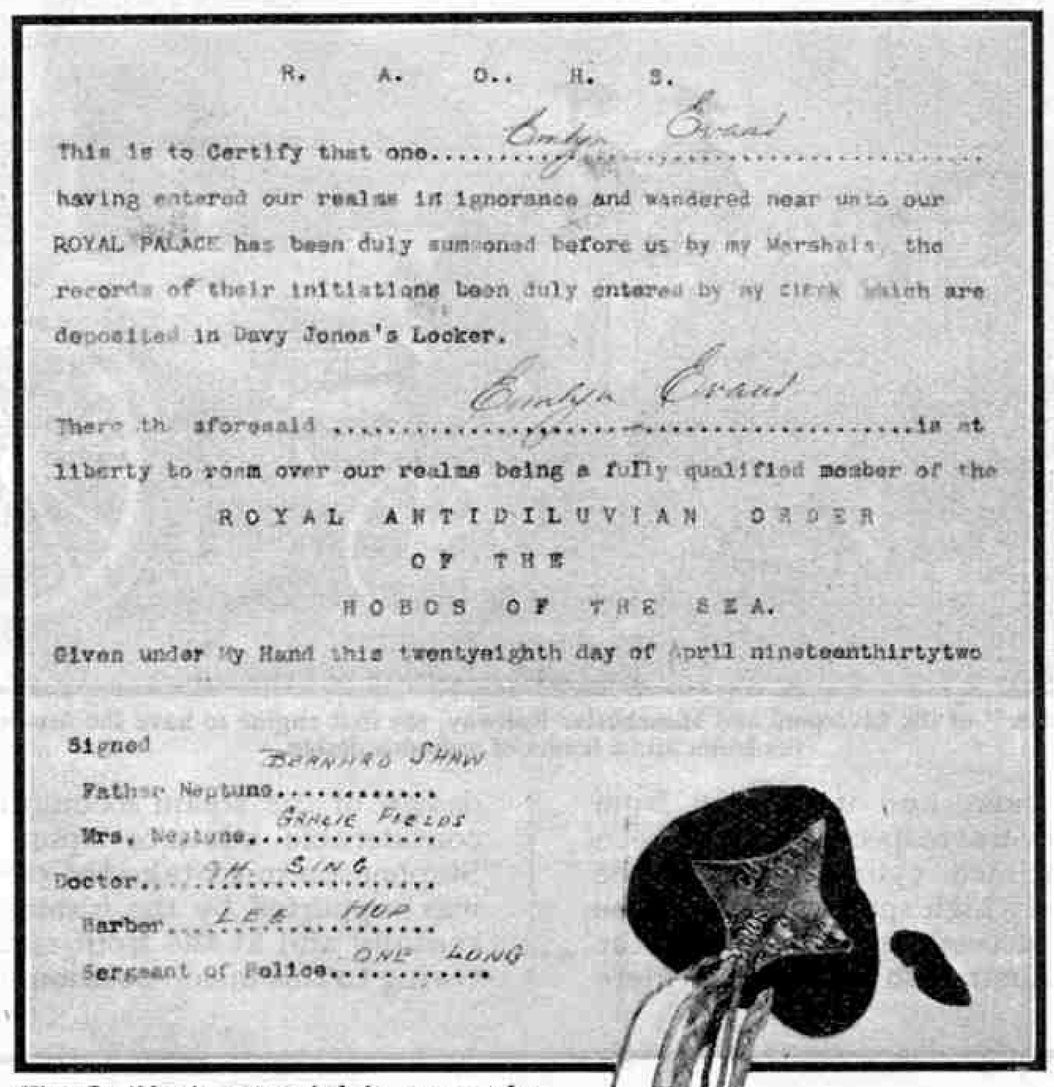
We anchored off Spezia after a voyage of about 12 days, and later heaved anchor and slowly moved into the docks to discharge our cargo. Spezia is a naval base where shipbuilding is carried on, and during our stay there I saw many large submarines and aeroplanes, in addition to vessels of the Italian Fleet. The largest seaplane I saw was of the "*Do.X*" type. This was not so large as the famous German machine, but it had 10 engines and made a deafening roar when flying.

After discharging the coal we had brought, we left for Oran, Algiers, for stores and bunkers. There I was interested in the gaily-dressed people, including Arabs and men of the French Foreign Legion, and I was sorry when we finished bunkering and left for Buenos Aires. We had not quite finished with Oran, however, for a little excitement was caused by finding two natives of that port who had hidden themselves on board in the belief that we were returning to Great Britain. They were taken ashore at Ceuta.

After passing through the Straits of Gibraltar we encountered fine weather and were able to fish by means of a line suspended from a spar. The older members of the crew described our catch as king fish. These were four ft. to six ft. in length and weighed 46 lb. to 78 lb. They were good to eat and helped to give variety to our food supply.

While waiting for orders, we remained at anchor in the roadstead at Buenos Aires for a fortnight. There the River Plate is about 20 miles in width, and our stay was greatly enjoyed, although we were kept hard at work painting the ship's sides. At last we were ordered up the river to Rosario to load grain. The voyage took a day and a half, and was made under the direction of a pilot. The river at Rosario is much narrower than at Buenos Aires, and while at anchor in it we experienced a pampero, a violent storm characterised by heavy rain, hail, thunder and high winds. During this storm the ship dragged her anchor and narrowly missed colliding with other vessels in the river.

On receiving our cargo we returned to Buenos Aires, where we completed loading and then left for St. Vincent, Cape Verde Islands, for further orders. During our outward voyage we had been unable to celebrate the crossing of the Equator owing to the presence of coal on deck. There were no obstacles on our return voyage, however, and the four novices in the crew were caught and treated in the usual manner. I was let off lightly, but the other victims were greeted with showers of salt water, thrown over them to the accompaniment of music from weird instruments. The celebrations could not be described as elaborate, but were sufficient for the four victims, who later were presented with certificates from Father Neptune to show that they had been initiated into the "Royal Antidiluvian Order of the Hobos of the Sea." A photograph of my certificate is reproduced. It certifies that a record of my initiation has been deposited in Davy Jones's locker and gives me permission to roam over the realms of Neptune. The imposing seal is made from pitch, rope ends and a star cut from a tobacco tin!



R. A. O.. H. S.

This is to Certify that one Evans Evans

having entered our realms in ignorance and wandered near unto our ROYAL PALACE has been duly summoned before us by my Marshals, the records of their initiations been duly entered by my clerk which are deposited in Davy Jones's Locker.

Evans Evans

There th aforesaid ..... is at liberty to roam over our realms being a fully qualified member of the

ROYAL ANTIDILUVIAN ORDER

OF THE

HOBOS OF THE SEA.

Given under My Hand this twentyeighth day of April nineteenthirtytwo

Signed BERNARD SHAW

Father Neptune.....

Mrs. Neptune. GRACIE FIELDS

Doctor. H. SING

Barber. LEE HOP

Sergeant of Police. ONE LONG

The Certificate presented to our reader, E. Evans, of Mardy, after "crossing the line" during a voyage on the S.S. "Clarissa Radcliffe."

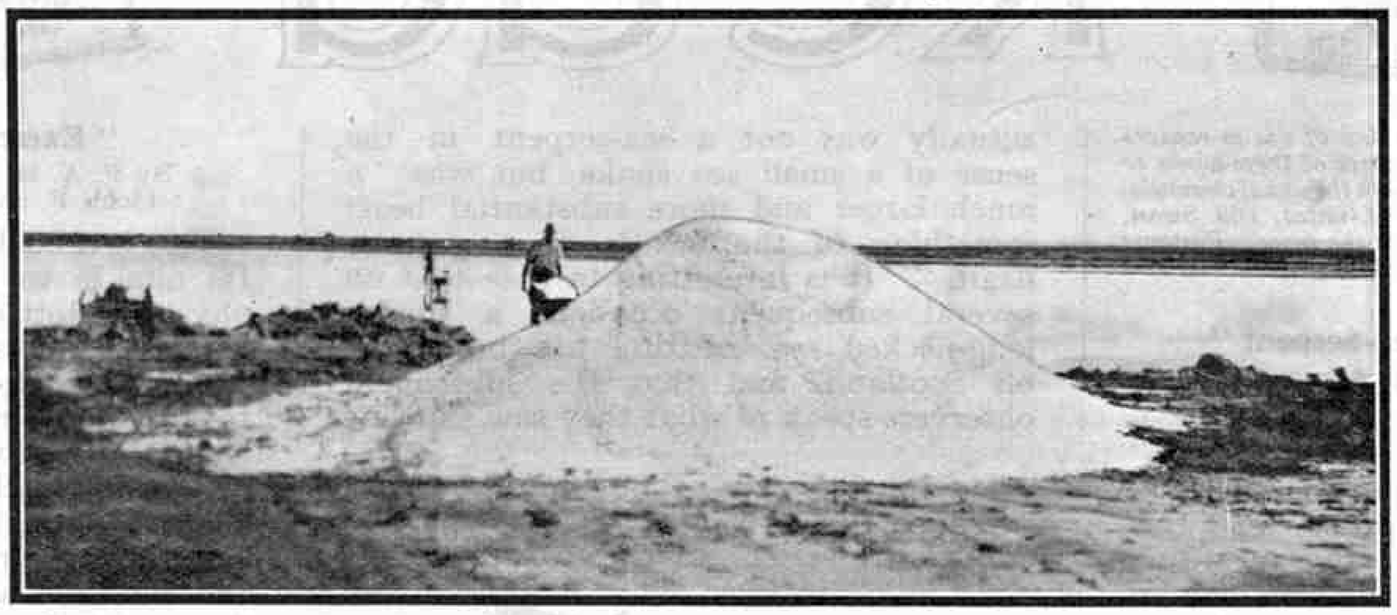
On arriving at St. Vincent we were ordered to Rotterdam and there we tied up in the River Maas while pneumatic grain elevators discharged our cargo of wheat. Then followed the voyage across the North Sea to South Shields, where the members of the crew were to be paid off. During the crossing, the sea was very rough and the ship rolled, pitched and tossed heavily. The voyage to the North of England required nearly two days, but it was very interesting indeed, for many vessels of widely different types were seen. I was sorry when the trip came to an end, and hope that my next voyage will be equally enjoyable.

E. EVANS (Mardy).

The Salt Harvest in Victoria

Last summer I watched the gathering of salt from salt lakes at Mystic Park, between the towns of Kerang and Swan Hill, in Northern Victoria. These lakes are surrounded by low hills and have no outlets. The salt beds are about nine inches in depth and in winter are covered with about three feet of water, but in summer this is reduced to a few inches. No vegetation grows on the shores of the lake, and the dazzling white sheets of salt reflect so much light that the men at work have to wear smoked glasses in order to protect their eyes from the glare.

The salt is only gathered during the summer months of January, February and March, when the heat of the Sun evaporates the water and salt crystallises out. Very fine crystals are first formed and the action of the wind causes these to be piled up in drifts around the shores of the lakes. They are raked into rows and shovelled into barrows to be carried ashore, where they are left in heaps for several months to be bleached by the strong sunlight. Later, when more water has been evaporated a plank roadway is laid across the lakes, in order to enable salt to be gathered from their centres. This salt is coarser than drift salt but is suitable for many purposes. It is left exposed to the sun for a few months before being packed into bags for despatch to those who make use of it.



Salt, in fine crystal form, being gathered from a salt lake at Mystic Park, Northern Victoria. Photo by our reader, E. W. R. Grace, Australia.

E. W. R. GRACE (Caulfield, Victoria).

A Miniature Power House

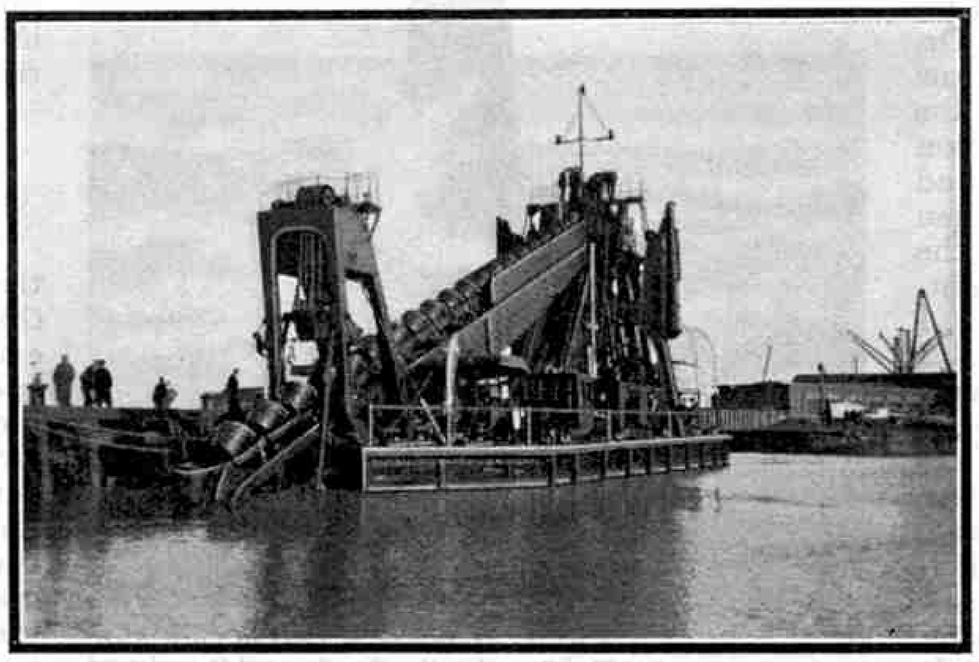
By building a small clay dam and using the flow of water in a stream to drive a water turbine connected to a miniature dynamo, I have been able to develop sufficient power to run my Meccano 4-volt motor. The embankment raises the level of the stream sufficiently to give a fall of four feet on the lower side, and from a pipe fixed at the top of the dam water pours out in a steady stream on to the waterwheel. The four paddles of this consist of the bottoms of four cigar boxes and are glued together round a long Meccano axle shaft and bound in position by means of wire.

The amount of water flowing varies, and the distance to which the jet is thrust outwards therefore changes. For this reason I found it necessary to mount the waterwheel on a runway built from Meccano parts. This runway is about 12 in. in length, and a second runway, also made of Meccano parts, accommodates the dynamo, which is driven by means of a belt consisting of a piece of string. I have made arrangements to peg both the waterwheel and the dynamo when in position.

J. ADAMS (Derby).

A Dock Trial in Port Glasgow

While at work one evening on the "*Tilbury II*," a non-propelling bucket dredger built in Port Glasgow for the Port of London Authority, I was told that next day I was to fill the lubricators on the hoisting blocks and to make other preparations for the dock trial that was to be carried out. Early on the following morning therefore I boarded the newly-completed dredger and made for what is known as the fore framing. This is the part from which the bucket ladder is lowered and hoisted as required and is clearly shown in the accompanying illustration. Armed with a can of oil, I climbed the vertical steel ladder to the upper hoisting blocks, unscrewed the lids of the shining brass oil cups, and filled the lubricators. Then I descended halfway to the deck in order to repeat the process with the lower blocks.



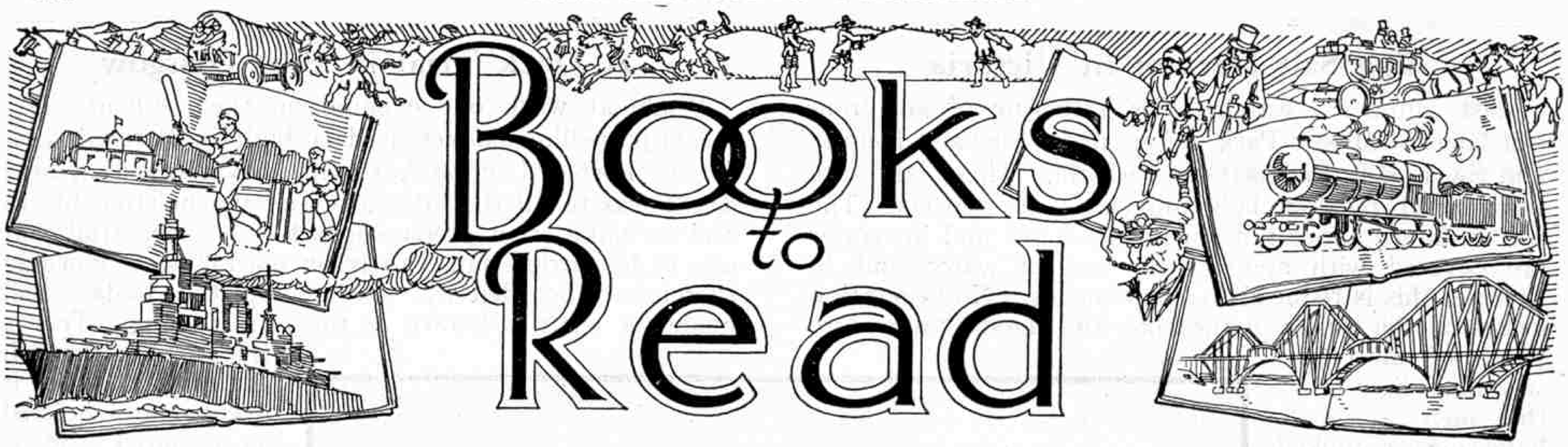
Testing a non-propelling bucket dredger built for the Port of London Authority. Photograph by our reader, J. Hutton.

My next task was to fill the oil boxes on the cylinder tops of the main engines. On entering the engine room for this purpose I was greeted by many different noises, including the chug-chug-chug of the pumps feeding the boiler with water, the smooth hum of the dynamos and the dull sound of the bilge and air pumps. The engine room itself was a scene of great activity, for the trial was about to start and every member of the staff was in position, ready to do his share of the work. I was on the grating above the engines, and there I poured oil into the boxes from which it is fed to the top end bearings and the guide shoes.

Suddenly someone stepped into the engine room and called "All clear." The stop valve was slowly opened and the massive arms of steel began to move up and down, transmitting the power through the crankshaft to the endless chain of buckets by means of two huge belts. The trial had commenced and everywhere I looked I saw moving machinery. Below me were the main engines and on my right were the governors swinging round tirelessly as they controlled the speed of the engines. The bright new flywheels of the dynamos glittered as they spun round at high speed and the centrifugal engine seemed to be trying to imitate the powerful main engines driving the massive gear wheels that operated the endless chain of buckets. Everywhere shining steel and brass were visible, a thrilling scene to a Meccano boy.

Every moving part ran smoothly and presently, when a voice from above enquired if everything was all right, the Engineer-in-charge was able to reply, "As cool as an iceberg!" This was perhaps an exaggeration, but it was a satisfactory indication that all was in order.

J. G. SANDERSON (Port Glasgow).



Here we review books of interest and of use to readers of the "M.M." We can supply copies of these books to readers who cannot obtain them through the usual channels. Order from Book Dept., Meccano Limited, Old Swan, Liverpool, adding 1/– for postage to the price. Postages on different books vary, but any balance remaining will be refunded.

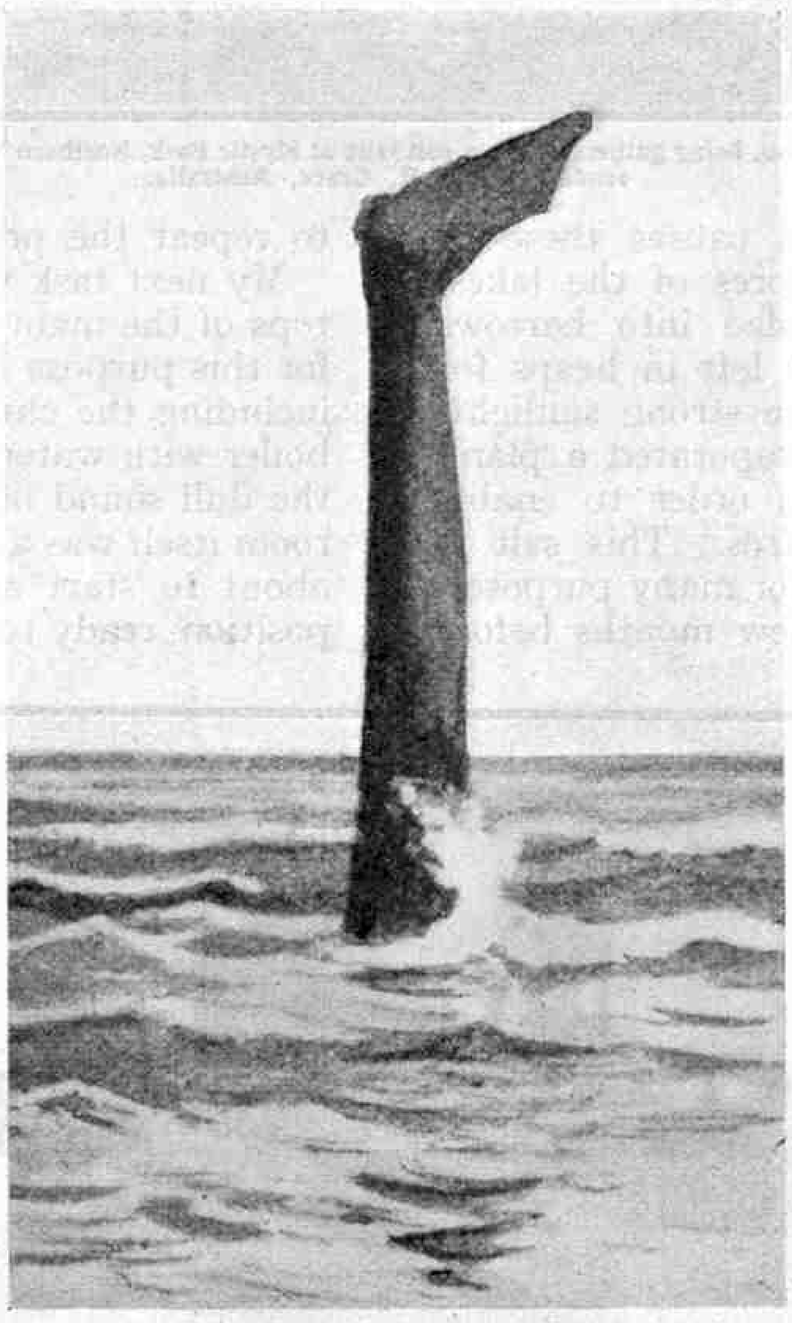
"The Case for the Sea-Serpent"

By R. T. Gould. (Philip Allen. 7/6)

To many people the sea-serpent is merely a myth, useful in the "silly season" for filling up an odd corner in our daily papers. But when such people read this book they will find that far from regarding the sea-serpent as a myth, Commander Gould makes a bold and vigorous challenge. He considers it a proven fact that these queer creatures do actually exist, although he admits they are rarely seen and are few in number. He has carefully analysed all the evidence and fully states the case both "for and against," giving chapter and verse for every statement of fact. In addition to his expert scrutiny of authenticated sea stories of the past, he discloses several recent reports that have not been published hitherto.

Many queer sea creatures have been seen in different parts of the world, but they are not confined to distant climes, several having actually been seen around the British Isles. The one illustrated on this page, for instance, was seen by Dr. Matheson in 1893 in Loch Alsh, the narrow strait dividing the Isle of Skye from the mainland. According to Dr. Matheson it was a beautifully clear day and he and his wife were "sailing gaily along, when suddenly I saw something rise out of the Loch in front of us—a long, straight, neck-like thing as tall as my mast. I could not think what it was at first. I fancied it might be something on land, and directed my wife's attention to it. I said, "Do you see that?" She said she did, and asked what it could be, and was rather scared. It was then 200 yds. away, and was moving towards us. Then it began to draw its neck down, and I saw clearly that it was a large sea-monster of the saurian type, I should think. It was brown in colour, shining, and with a sort of ruffle at the junction of the head and neck. I can think of nothing to which to compare it so well as the head and neck of the giraffe, only the neck was much longer, and the head was not set upon the neck like that of a giraffe; that is, it was not so much at right-angles to it as a continuation of it in the same line. It moved its head from side to side, and I saw the reflection of the light from its wet skin."

The creature was in sight for about two minutes and then sank beneath the water but it subsequently appeared three times more at intervals of two minutes, when it raised its head and neck above the water and appeared to be looking round. Dr. Matheson expressed the opinion that this actually was not a sea-serpent in the sense of a small sea snake, but was "a much larger and more substantial beast something of the nature of a gigantic lizard." It is interesting to note that on several subsequent occasions a similar long-necked sea creature has been seen off Scotland, and that the subsequent observers speak of what they saw as being exactly similar to the drawing illustrating Dr. Matheson's sea monster.



The sea monster seen by Dr. Matheson in 1893 in Loch Alsh, Scotland. From "The Case for the Sea-Serpent" reviewed on this page.

In conclusion, Commander Gould states that "the evidence available demonstrates the real existence of more than one type of creature not yet scientifically described . . . the creature much resembling in outline and structure the Plesiosaurus of Mesozoic times. I do not suggest that the last named is actually a Plesiosaurus but that it is either one of its descendents or has evolved along similar lines."

This most interesting book, on a fascinating subject, from which humour is not missing, is illustrated with numerous sketches of the queer creatures with which it deals.

"Exercises for Athletes"

By F. A. M. Webster and J. A. Heys
(John F. Shaw & Co. Ltd. 7/6 net)

This is a book quite out of the ordinary. Its aim is to analyse the mechanics of physical effort in such a manner as to lay bare the secrets of the fundamental principles that alone can ensure success in these days of intense athletic competition. No athlete, however gifted, can rely upon his natural ability to ensure success; he must study in minute detail every movement in his particular branch of athletics, and by incessant practice bring each of these details to the greatest possible perfection.

"*Exercises for Athletes*" provides a series of well-thought-out exercises for almost every type of athletic event, each exercise aiming at developing the strength, control, and perfect timing that these events require. It is lavishly illustrated by action photographs of quite remarkable interest, and these, together with the clearly-written descriptions, make it impossible for any reader to misunderstand the idea underlying each one.

Hitherto Great Britain has lagged behind in the race for international honours, but if British athletes base their preparation upon the principles laid down in this volume, they need fear no foreign rivals on the ground of efficient training.

"Practical Railway Operating"

By T. B. Hare
(Modern Transport Publishing Co. Ltd. 5/– net)

This book is intended to supplement the author's earlier work, "*British Railway Operation*," its special purpose being to examine the practical aspects of railway operation in regard to matters that are prominent to-day. The problems that face the railway officer are dealt with in detail, and the various possible solutions are considered one by one. An important feature of the book is the extensive use made of tables and diagrams to illustrate the points under discussion. This book is technical, but will be of interest to keen railway enthusiasts.

"Bluejacket and Corsair"

By John G. Rowe. (The Epworth Press. 3/6 net)

This is an excellent boys' story. Tom Penwarden, a fisher lad, is seized by the press gang to serve on a man-of-war. After a mutiny on board, he and a few companions find themselves prisoners in the hands of Spaniards in South America. They escape and pass through a series of thrilling adventures while fighting with revolutionaries in Venezuela. Subsequently Tom reaches home, but his troubles are not yet over, for on his next voyage he is captured by corsairs, taken to Algiers, and sold as a slave. After passing through a terrible experience he arrives home once more, and there an interesting story ends.

"A Hunter Talks"

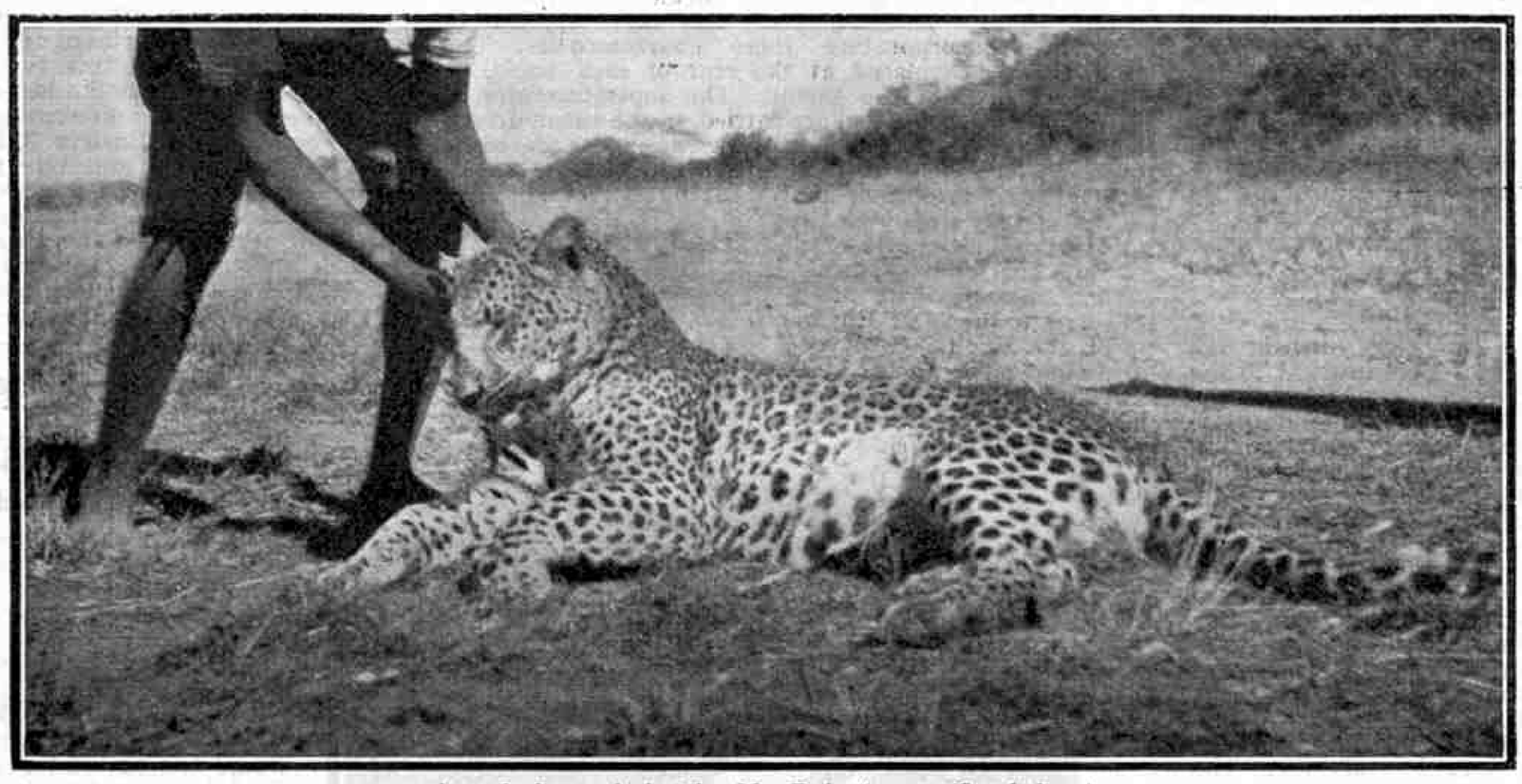
By W. Robertson. (A. G. Stockwell Ltd. 6/- net)

Readers of the "*M.M.*" will revel in this account of the adventures of a hunter in the wilds of Rhodesia. Mr. Robertson spent nearly 20 years in that country, travelling through the bush in the days when game was more abundant than it is now, and when there was always the risk of walking into the midst of a horde of resting elephants, or of being charged by a rhinoceros or a buffalo disturbed by the approach of a line of carriers.

Mr. Robertson's chief hunting grounds were the Zambesi valley country and the plateau south of the great valley, 40 miles in width, through which the river runs. He begins his story with an account of his adventures with the elephant. He describes this as the king of African game beasts, and he arouses in the minds of his readers a great respect for the strength and intelligence of this creature. In spite of its size, a motionless elephant cannot easily be seen, for in the forests its great bulk usually is almost completely hidden by foliage, and it is possible almost to walk into it before realising its presence. The sudden appearance of a man within a few yards of a dozing elephant invariably provokes a charge, and the author has many exciting stories to tell of furious attacks by startled animals. If left alone they simply decamp as soon as they scent the approach of their human enemies.

The rhinoceros also does not wantonly attack human beings. Mr. Robertson points out that this animal is practically blind, and expresses the opinion that it is only dangerous in the same way as an express locomotive. A rhinoceros, he says, never charges with intent, and if a hunter stands still will dash past him, for it is really running away! The author gives many instances to prove that the greatest danger with these animals is that of meeting one when walking along a narrow game path through dense bush.

The author gives the buffalo the credit of being the most dangerous of African game animals. If wounded, this creature never charges the aggressor, but adopts a more subtle and effective method of retaliation. He careers off into the forest and swings round in a circle into a position where he can lie in wait for his assailant. In Mr. Robertson's words, "he waits and watches till his pursuer, whose eyes are fixed ahead and on the spoor, has passed his hiding place. He then suddenly charges out from behind, and before the hunter has time to turn or to raise his rifle the buffalo has transfixed his enemy with one sweep of his massive horns, trampled him down and left him dead on the track." Looking for a wounded buffalo in the thick bush seems to be a nerve-racking task, but Mr. Robertson relates instances in which he has done this.

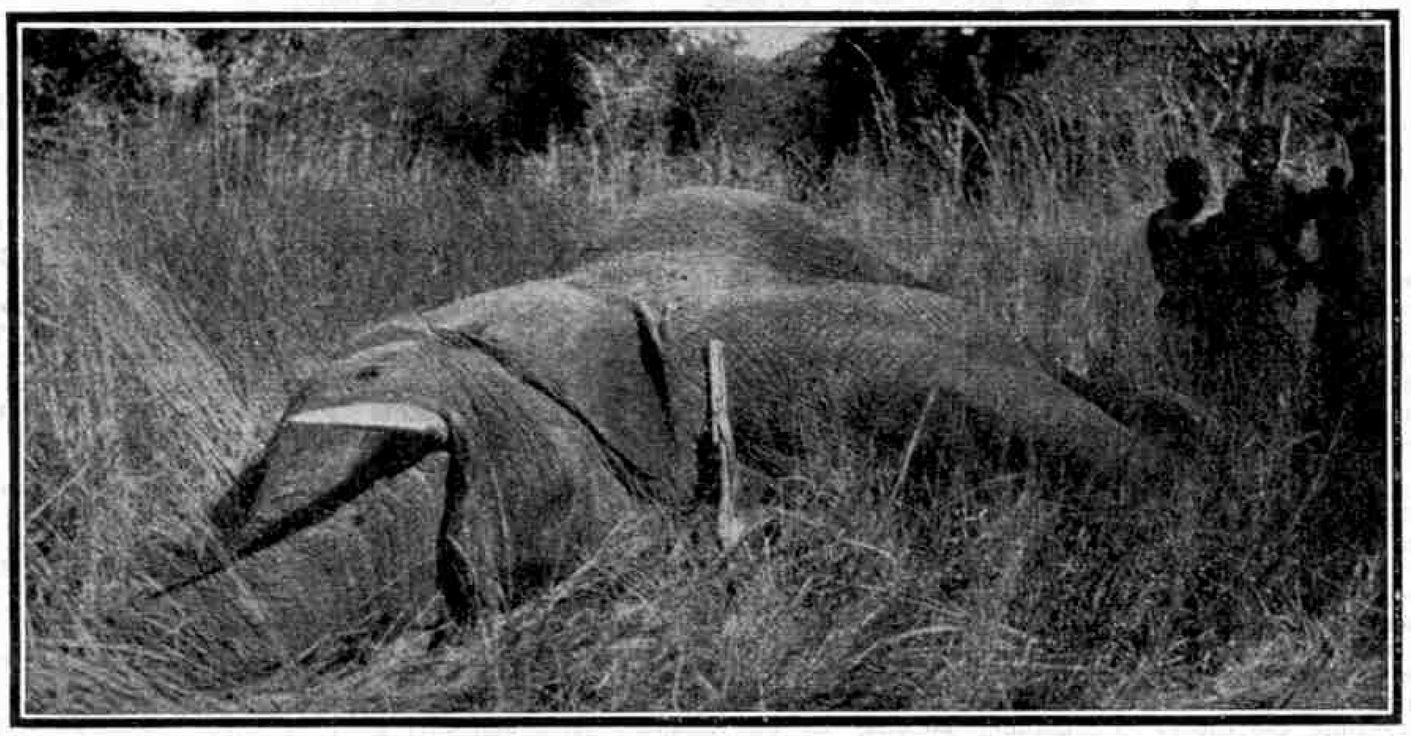


A male leopard shot by Mr. Robertson. (See below.)

The massive hippopotamus appears to be a comparatively inoffensive creature, for it is not aggressive, and the flimsiest fence seems sufficient to keep it away from the natives' crops. A friend of the author's who happened to pitch his camp on a hippopotamus track was rudely interrupted one morning while at breakfast by the sudden appearance of a hippopotamus followed by a calf. The two creatures passed unconcernedly right through the camp, knocking over the kettle on the camp fire and spilling its contents. At sundown back they came again in the opposite direction. For the second time they crossed the fire, kicking over the stew that was to form the hunter's frugal dinner and scaring the cook boy out of his wits. The hunter then took the hint and moved his camp.

Mr. Robertson has interesting stories to tell of hunting lions—animals that he does not admire very greatly—leopards, crocodiles, antelope and similar game. In addition he deals with the natives and their customs, and one of the most attractive sections of the book describes in an unassuming manner his daily life during his excursions into the wilds. He dispensed with many things that are usually considered essential, and did not even make use of a tent, preferring to roll himself in blankets on a bed of grass. He learned by experience the necessity for such precautions as the use of a mosquito net, or turning boots upside down and shaking them before putting them on, in order to remove toads, or even poisonous night adders, that had made themselves comfortable in them during the night. He records an occasion when his blanket was completely eaten under him by termites!

The author writes that "Africa is changing . . . civilisation and settlement inexorably advances and game and the unsophisticated native vanish before it." He regrets the passing of the "low rumble of the heavy ox-waggon" and the end of the romance of the African forest and big game region, but his account of the years he spent there will enable his readers to appreciate to some extent the fascination of the hunter's life.



A fine specimen of a bull elephant. From "A Hunter Talks," reviewed on this page.

"The Arabian Nights"

By A. E. Jackson. (Ward, Lock. 3/6)

The story of the Arabian Nights never grows old. It is difficult to say which we like best—Ali Baba and his Forty Thieves, Sindbad the Sailor, Aladdin and his Wonderful Lamp, the Sleeper Awakened, and the Talkative Barber, all contend for the place of favourite.

The present edition, with its 24 beautiful plates in colour, will make an admirable present for a younger brother or sister.

"A Nature Calendar"

By Eric Fitch Daglish (J.M.Dent&SonsLtd. 6/-net)

Mr. Daglish is well known as a writer on natural history topics, and this book consists of a collection of his weekly nature notes that appeared in "*Everyman*." These have been revised and re-arranged, and now form an interesting commentary on the wild life of each month in the year. Mr. Daglish writes in an easy and pleasant style, and has the ability to describe wild creatures, great and small, with a sympathetic understanding of their life problems. There is none of the formality that spoils so many natural history books; one feels a sense of direct contact with Nature. Every page is packed with information, but there is never a moment's dullness, each chapter bearing clear evidence that the author recorded the various scenes and events while they were still fresh and vivid in his mind.

Sleuth Hounds of the Navy—(*Con. from p. 735*)

demanded so much attention as to leave little space for destroyer records. But these 'light horsemen,' with their dash and rush into the very entrance of death, made during those four years, 1914–1918, some of the most glorious episodes in all our naval history. No artist could ever adequately depict the sight of a 33-knot destroyer rushing at full speed, bows up, stern down, oil smoke issuing from funnels, the white ensign flying stiff as a board at the masthead, a great white semi-circular wave rising on either side of the hull as the razor-like stem goes cutting through the sea, officers and men at their stations, guns and torpedo tubes awaiting only the critical minute, and a mighty roar of wind swishing from forward to aft by that own-made hurricane. The senses can take in some of these, but not all, at one time; and even then there still remain that restrained excitement, suspense, the thrill of motion, the eagerness to attack—which the painter's art can never set down and the photograph utterly fails to catch."

Welland Ship Canal—(*Continued from page 738*)

nearly in the position it was to occupy when in use. The necessary girders and plates were brought to the site on the construction railway running along the west side of the canal. The leaf on the opposite side was first built, the materials being placed in position with the aid of a huge boom mounted on the pin on which its companion leaf was to swing, and held in place by means of ties. Then the boom was removed and the second leaf constructed, the girders and sheathing plates this time being handled by a locomotive crane.

During erection the leaves rested on temporary concrete pedestals set on the floor of the lock, and the bottom girder was carefully levelled by means of wedges in order to ensure that the leaf erected on it should be truly vertical. When each leaf was complete it was jacked up and the concrete pedestals were removed for similar service elsewhere. The leaf was then lowered on to roller tracks and moved backward through the necessary distance to enable it to be lowered on to its pin. The upper hinge pin was then connected to the anchorage provided for it, and on removing the rollers and wedges the leaf swung freely in its correct position.

About 40,000 rivets were employed in the erection of each large leaf and about 16,000 in the construction of those used at the upper end of the locks. Some 20,000 rivets were employed in erecting the leaves of the guard lock.

As it would be a very serious matter if a gate were carried away by a vessel, fenders have been provided to protect them. Each of these fenders consists of a steel wire rope, 3½ in. in diameter, stretched across the lock. The rope is carried by a light structural steel arm that operates in a similar manner to a rolling lift bridge. Sufficient resistance is provided by fixed bollards and friction drums to bring up any vessel before she strikes the gates.

(*To be continued next month*)

Sea Dogs of the North—(*Con. from p. 745*)

landed safely on a nearby ice floe and as it was obvious they would have to spend the night there they made themselves as comfortable as possible under the circumstances. As the evening passed they watched the ill-fated "*Bayeskimo*" sink slowly by the head, and about ten o'clock she finally disappeared beneath the ice and water. During the night heavy rain fell but the shipwrecked company kept their spirits up, and two of them, one a missionary and the other a young apprentice clerk of the Hudson's Bay Company, entertained the passengers with songs and music.

When dawn came the crew soaked some of the deerskins in gasoline and set them on fire in the hope that the huge spirals of smoke which rose skyward would attract the attention of those on board the "*Nascopie.*" The plan succeeded and about seven o'clock on Friday morning the officer on the bridge of the "*Nascopie*" saw the smoke on the horizon, and the steamer was steered towards it, arriving in the vicinity of the marooned party less than two hours later. The crew and passengers of the lost steamer had already taken to the boats again in readiness to row to the approaching "*Nascopie,*" and as it pulled up they greeted it with a rousing cheer. They were soon safely on board the ship.

Flexible Locomotives—(*Continued from page 764*)

Mallet himself always insisted that the step was not in accordance with the principles of the design, but modern improvements have overcome the early difficulties and made single-expansion "Mallets" a success.

"Mallet" locomotives are employed for all kinds of services on narrow gauge systems, while on standard gauge lines, particularly in America, they are used for banking and shunting duties in addition to the haulage of heavy freight and mineral trains. A disadvantage of the type is that owing to the front unit only moving on a curve, the boiler is displaced towards the outside of the curve. It is therefore a less satisfactory design in this respect than a locomotive that has two movable trucks.

The "Kitson-Meyer" locomotive is a very interesting design. The same general principles as in the "Fairlie" and the "Mallet" are employed and it is very similar in appearance to a huge tank engine, except that the tanks are placed rather far forward, leaving the firebox sides unobstructed. Kitson & Co. Ltd., of Leeds, introduced a number of modifications to the original Meyer engine, and as a result the name "Kitson-Meyer" has been applied to engines incorporating these characteristics. The cylinders are placed at the rear of each bogie, or at each end of the engine. The superstructures of engines of this pattern are carried on the steam-driven bogies. These bear the load on two pivots placed as nearly as possible to the centre of the coupled wheelbase, and thus their movement on curves approximates very closely to that of an ordinary bogie coach. Both bogies partially rotate and accommodate themselves to the rails. Engines of the original "Meyer" design have their cylinders facing each other at the inner ends of each bogie; and the superstructure is carried on the rear bogie by means of special bearings and brackets and on the front bogie by a spherical pivot so as to allow for the variations in level and curvature that are encountered on the road.

A baby elephant stands patiently while his weak leg is being strapped up to support it. He seems to know that the uncomfortable apparatus is for his own good.

The engine shown in the illustration on page 764 was built by Kitson & Co. Ltd., for service in South America on the 3 ft. gauge Colombian National Railway, which is noted for a continuous stretch of extremely severe gradients, the maximum being about 1 in 25. The engine may be regarded for all practical purposes as consisting of a pair of "Mogul" or 2–6–0 engine units supporting the boiler, tanks and bunker in the manner peculiar to the design. Although only a relatively small locomotive, the tractive effort at 85 per cent. of the boiler pressure is 40,000 lb., or very slightly below that of a G.W.R. "King," so that the possibilities of articulated designs in the matter of power are well brought out by this comparison.

A later development has been the 2–6–2 : 2–6–2 or "double Prairie" type, and a step further gives us the 2–8–0 : 0–8–2. Locomotives of the former pattern are in use on the extremely tortuous Kalka-Simla Railway in India, on a gauge of 2 ft. 6 in. Examples of the latter are found on the Great Southern Railway of Spain. As it was required that these should handle heavy mineral traffic over a line of somewhat light road bed, a design of adequate power was called for, yet without an excessive concentration of weight. It is noteworthy, therefore, that although the engines have an adhesion weight of over 90 tons, the average load on each axle is not more than 11 tons 7 cwt. The special merits of the articulated locomotive for such duties are obvious. There are many locomotives of the Kitson-Meyer type in use in Spain and South America.

Locomotives a Century Ago—(*Con. from p. 765*)

the 0–4–2 for goods. The 2–2–2 example was the "*Patentee,*" so named because it was constructed under a patent taken out by Robert Stephenson; and this 1834 engine was the pioneer of the type of engine that, with various modifications from time to time, was used to run express trains, not only in this country but also abroad, for many years afterwards. The design was adopted and developed by many of the locomotive building firms in addition to Robert Stephenson & Company, the celebrated "little Sharps," "large Hawthorns" and other famous engines of the forties and fifties being of this pattern. The Midland, Great Northern and Great Western railways in particular used this type of single-driver for a long period, and on the last-mentioned line the type survived until the present century.

The old South Eastern Railway also had a famous class of engines of this type for the Continental mail trains to Dover, and they were generally known as the "*Mail*" engines. They were fitted with the patent form of coal burning fire-box developed by their designer Mr. Cudworth. This was extremely long and was divided lengthways by a "midfeather" or partition, thus making necessary two fire-hole doors.

Meccano Aerial Bombing—(*Con. from page 775*)

its centre at the vertical axle about which the revolving arm turns.

The Motor Control and Final Wiring

In operation the aeroplanes are rotated at a comparatively slow speed, and a Meccano Resistance Controller 31 is therefore included in series with the Motor. A short fixed resistance composed of Meccano Cord is also included in the circuit, so that the minimum speed may be kept very low.

One terminal of the Motor is first of all joined to the Terminal 32, which is insulated from the frame and one end of a short length of Spring Cord is secured to it. The other end of the Spring Cord is attached to the Terminal 33, which is in contact with the frame of the model. The other Motor terminal is joined to one terminal of the Resistance Controller 31. This completes the "internal" connections, and it only remains to couple up the Motor with the source of current supply, which may be either an Accumulator or a Transformer.

A length of flex 34 is first of all attached to one of the Terminals 21 and the flex is joined to one pole of the Accumulator or Transformer. A length of flex attached to the second Terminal of the Resistance Controller 31 is also secured to this pole of the Accumulator, and finally a length is joined between Terminal 33 and the second pole of the Accumulator.

To operate the game, the Accumulator, etc., is connected as described, and the bombs are slipped into the solenoids in the aeroplanes. The Motor is then started up in a clockwise direction and the aeroplanes are set at the required speed by means of the Resistance Controller. The players then take up positions at each end of the model with their fingers on the bomb-release keys 22. When their own aeroplane sails past over the target the key is depressed and the bomb drops, registering a direct hit on the "Field Head Quarters" or some other important position in the enemy's line!

It is a good plan to provide distinctive markings for the aeroplanes so as to avoid confusion among the players. One plane, which might belong to the "Red" army, could be provided with a small cardboard disc coloured red. The other machine, which would form one of the "Blue" army's fighting units, would be provided with a small blue identification disc. It is important to note that the model must be disconnected from the Accumulator at the finish of play, as otherwise current will flow through the solenoids even though the Motor is not running.

Junior Section—(*Continued from page 797*)

Considerable race traffic is handled in connection with Newmarket, and as this is a great training centre in addition, suitable provision has to be make for the carriage of horses. Such features should not be neglected on a Hornby railway, particularly as horses are included in the set of miniature animals now available, and may be carried quite satisfactorily in Cattle Trucks. An all-Pullman Race Special will of course cause no difficulty in its make-up, and may be distinguished by a Special Train board.

Another feature is the fact that the Royal residence at Sandringham is situated within G.E. territory, the actual station being Wolferton. At intervals, therefore, Royal trains will be necessary, hauled by spotlessly clean engines displaying the special head code. As a rule this is four lamps, one on each buffer beam bracket and one below the chimney. On the G.E. section discs are used for lamps during daylight, so that small circles of white card will be required to mount on the brackets of Hornby Locomotives. They should be about ⅜ in. in diameter, and if small strips of paper are stuck on to form loops at the back of them, they may be easily fitted to the engine in the appropriate manner.

INDEXING A COLLECTION OF RECORDS

I RECEIVE many requests from readers whose records are steadily increasing in number, for advice as to the best method of indexing them. Some method of indexing is necessary with a collection of any size, as otherwise a great deal of time and temper is expended in trying to find a particular record, and the impatient handling of other records during the search is likely to result in damage.

When I first began to acquire a collection of records I divided up the available space in an empty cupboard into sections each intended to contain a separate class of record—orchestra, military band, piano, violin, and so on. This scheme worked successfully for a time; but presently, while some sections still had ample room, others were overflowing to a serious extent. Finally I decided to do away with the sections entirely, and simply to place the records in the cupboard without regard to nature of subject, and to rely entirely on the numbering of the envelopes for finding any record required.

The plan I recommend for general use is as follows. I will suppose that a cabinet or cupboard with two shelves is available. First of all each record is placed in one of the cardboard envelopes obtainable from any dealer, or in one of the envelopes that may be provided with the cabinet. These envelopes are numbered consecutively in the outer top corner, so that the number is readily seen. For convenience the upper shelf may be called "A" and the lower one "B." If now each shelf will hold, say, 50 records, those intended for the upper shelf will be marked "A1," "A2," "A3," and so on up to "A50"; those for the lower shelf will be marked "B1," "B2," and so on. As each new record is obtained its title is entered in a stiff-backed exercise book that has been divided up into separate sections, such as orchestra, military band, piano, violin, vocal, etc.; and opposite each entry is placed the letter and number of the vacant envelope into which the record is to go. When any particular record is wanted, it is looked up in the appropriate section in the book, its shelf letter and number is found, and then one can go straight to the cabinet and pull out the record without the slightest delay.

Mary Hagan, the child comedienne, who has made two remarkably successful records. Photograph by courtesy of the Decca Record Co. Ltd.

In addition to the ordinary index book it is a good plan to have another one in which the most important records are indexed entirely under the name of the composer. This second book adds greatly to the interest of the collection, and is specially useful to hand to a friend to enable him to choose the records he would like to hear.

If the records are stored in albums, the same arrangement may be made to apply by lettering the albums "A," "B," "C," and so on, with a separate set of numbers for each.

The scheme I have briefly outlined will be found quite satisfactory for dealing with even quite large collections of records. There is only one further point that need be mentioned, and this is that if possible 12 in. and 10 in. or smaller records should be kept separate. The best plan is to devote a shelf or certain albums entirely to the smaller discs.

A Child Comedienne

I am glad to be able to reproduce on this page a portrait of Mary Hagan, aged 12 years, who has made two Decca records that have had an immediate success. This child supported her unemployed father, who is a Newcastle ex-boxer, her invalid mother, and a small sister, with pennies earned by singing in the streets of Newcastle. She attracted the attention of Mr. Ted Broadribb, the well-known boxing trainer, who took her to London where she sang before a large audience at one of the big boxing matches at the Albert Hall. She was then taken in hand by Mr. Horace Sheldon, Musical Director of the Victoria Palace, London, who secured engagements for her at all the large music halls.

Mary has a remarkably powerful voice for her age, and in her singing shows a marked personality. Her two records, both 10 in. Blue Labels, price 1/6, are Decca F3018, "*Sally*" and "*Twiddle My Thumbs*"; and Decca F3052, "*My Daddy*" and "*My Home Town.*" These are well up to the high standard of recent Decca recording.

Records Worth Buying

The most striking recent orchestral record is that of the "*Tannhäuser*" overture made by William Mengelberg and his Concertgebouw Orchestra (Col. LX170 and LX171, 12 in., 6/– each). This overture has been recorded over and over again, but never so well as on these two discs. The brass tone is really magnificent, and a notable feature of the recording is that the violins are never drowned in the great climax, as is the case with almost every other record I have heard.

Two other popular overtures are issued by Decca-Polydor. These are the brilliant "*Light Cavalry*" overture of Suppé, played by the Berlin S.O. Orchestra (PO 5040, 10 in., 2/6), and Donizetti's old-fashioned but charming overture to "*The Daughter of the Regiment,*" played by the Berlin Philharmonic Orchestra (LY 6031, 12 in., 4/–).

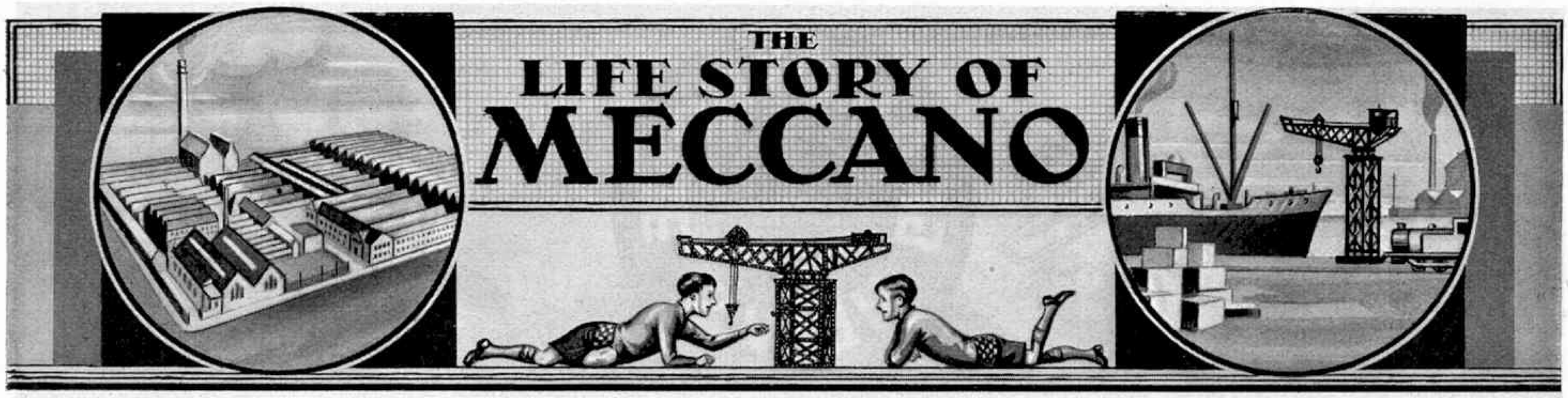
There is nothing particularly thrilling among the recent band records. The only one that can be described as "rousing" is that of two old favourites, "*Soldiers of the King*" and "*Soldiers in the Park,*" played by the B.B.C. Wireless Military Band (Col. DB878, 10 in., 2/6). The Welsh Guards Band play "*Vienna Maidens' Waltz*" and "*The Water Melon Fete*" in spirited style on Broadcast 3212 (10 in., 1/6); and the Wingates Temperance Band give a splendid example of first-class brass band playing in two marches, "*Avondale*" and "*Washington Grays*" (Decca F3035, 1/6).

The "hill-billies" that are so popular just now have the peculiar feature that either you are keenly enthusiastic about them or you hate them bitterly—half measures are not possible. These curious productions are heard at their best in the records of Carson Robison and his Pioneers. Among them may be mentioned "*Steamboat Keep Rocking,*" and "*The Runaway Train*" (Sterno 995, 1/3); "*Ain't ya Coming Out To-night*" and "*Swanee Kitchen Door*" (Broadcast 3214, 1/6); and "*Goin' Back to Texas*" and "*Why Did I Get Married*" (Sterno 994, 1/3). Ten of the best of these "hill-billy" songs are recorded by Carson Robison on an "omnibus" Columbia record (DX 365, 12 in., 4/–).

Paderewski plays two Chopin mazurkas, Op. 59 No. 2, and Op. 33 No. 2, on H.M.V. DA 1245 (10 in., 4/–). In many respects this is Paderewski's best record, for there is much less of the hardness of tone that has characterised his previous records, due largely to the peculiar tone of the Erard piano used by the pianist.

Two charming violin solos, Drigo's "*Les Millions d'Arlequin,*" and Drdla's "*Serenade,*" are recorded by Mischa Elman on H.M.V. DA 1214 (4/–).

A splendid Cossack record that should not be missed is Decca-Polydor PO 5042 (10 in., 2/6), "*Cossack Choir with Balalaika Orchestra.*"



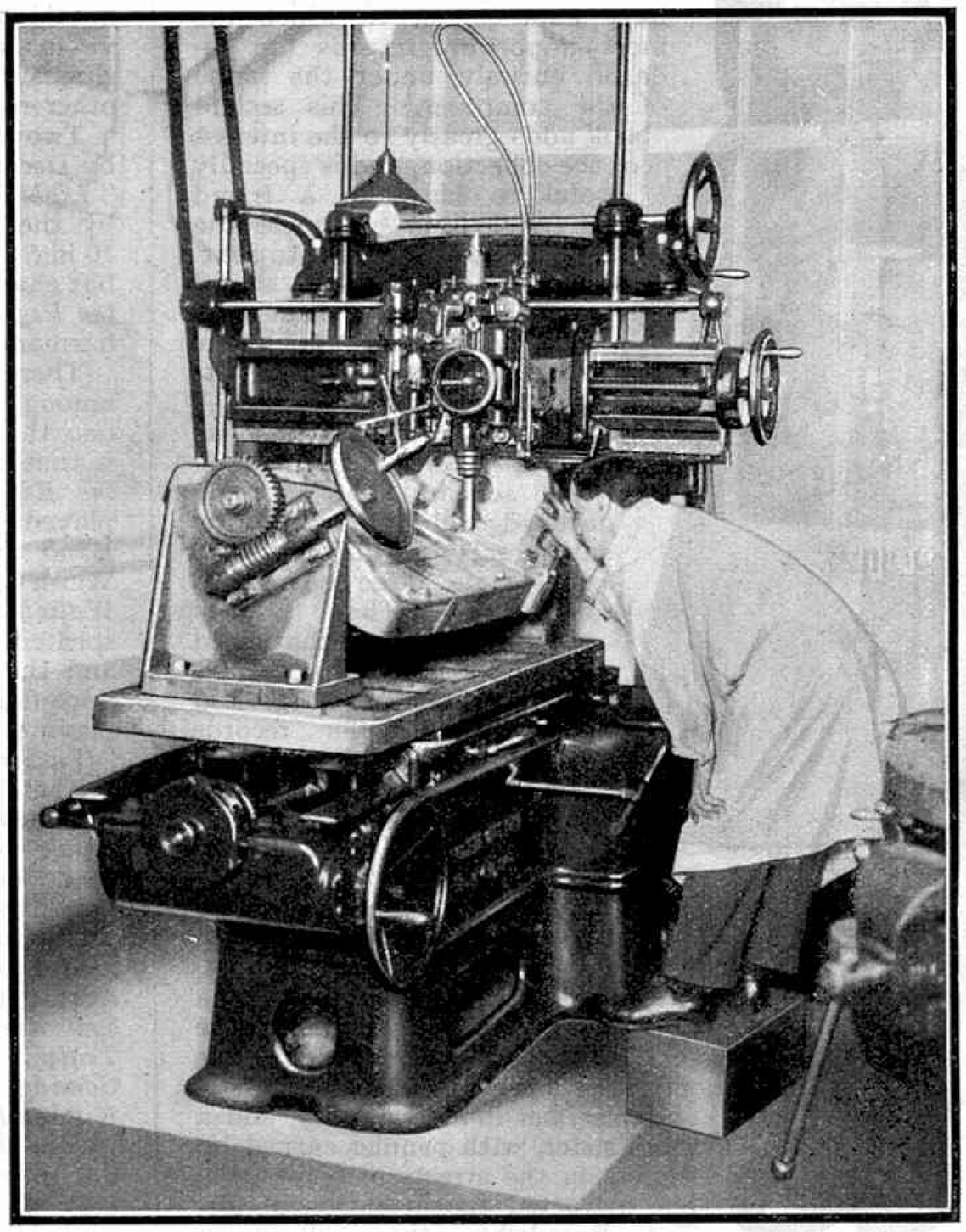
IX.—By Frank Hornby

THIS month I commence my promised description of the Meccano Factory and the varied and interesting processes that are carried out in it. I am writing this particularly for readers who may be unable to visit the Factory, but at the same time I hope my account will come as a pleasant reminder to those who have already made a tour of the Factory with one of our special guides.

The plan reproduced on the next page, taken in conjunction with the little sketch reproduced in the heading above, will be helpful in making clear the layout of the Factory, which covers an area of nearly five acres, and gives employment to over 1,100 workers.

Perhaps the best way of explaining the work of the various departments of the Factory will be to describe the processes through which a new item added to the Meccano or Hornby Series must pass. First of all instructions are issued to our designers to prepare samples and estimates of manufacturing costs, and in due course these are presented to the Directors. They are considered in conjunction with the type and style of packing to be employed, and the quantity that may be expected to sell during the ensuing year. Finally, when a decision on these points is reached, orders are issued to the Works to manufacture, let us say, 50,000 of the new article.

Drawings of every part of the new product, schedules of the quantities of material required and of the operations involved and their sequence, are prepared. A set of blue prints from the drawings is sent through to the Tool Department for the designing and the making of the tools, with which the components of the new product will be manufactured. This work must be carried out within very fine limits and a high standard is rigidly maintained. The great popularity of Meccano and Hornby Trains is due in no small measure to the precision of the work of our Tool Department.



The complicated mechanism of the jig-boring machine, referred to in our description of the Tool Department, is excellently revealed in this illustration.

In its simplest form a press tool consists of a punch and a die, relative in shape, so that when a piece of metal is placed between them and pressure applied a desired form is produced. Typical simple tools of this type are those used for blanking metal shapes from sheets or coils of metal; piercing tools, the function of which is obvious, and forming tools that bend pieces of metal to desired shapes. A press tool can be carried into many stages of complication by the multiplication of the operations it is required to carry out at one stroke of the press. These are known as "compound" tools, and may actually carry out all the processes of blanking, piercing, and forming at one operation, and in addition assemble components at the same time. An instance of a simple set of tools may be cited in those required to emboss a design on metal, say the window framing of a passenger coach. The lower part of the tool, clamped to the bed-plate of the press, has the actual design cut into its surface in reverse. The top tool, fixed to the ram of the press, bears the design in relief, allowances being made in this relief work for the thickness of the metal to be pressed between the two parts of the tool.

The production of a set of tools is a long job. In the case of the tools for one of our better classes of train sets—a No. 2 Special, for instance—the task may involve several months' work with an ultimate cost running into thousands of pounds. Every individual operation in the production of a train set calls for a specially designed tool, and in this particular instance more than 300 press tools are required.

On receipt of the prints for the new product the tool designer proceeds to lay out the design for the tools. A requisition showing the dimensions and specification of all the material required to make the tools is sent to the Stores, where the required material is prepared. Preparing the steel for issue to the tool-maker may involve cutting perhaps 20 pieces of steel from bars to stated sizes. This is done by a circular cold saw that in three minutes will cut through a bar of mild steel 6 in. in width and 2 in. in thickness. It takes rather longer to cut through the higher grades of steel such as a carbon tool steel, or a chromium alloy steel. Each part of the tool is made from the steel particularly suited to the work it will be called upon to perform. For instance, the base plate of a tool is invariably made from mild steel or cast iron, whereas the die will be of cast or alloy steel.

The first operation after receiving the tool steel in the Tool Department is to machine or grind the pieces on all surfaces. From this point the job is put into the hands of a tool-maker who will be held responsible for the production of this particular tool. He proceeds to outline the shape of the tool on the steel and to do all the preparatory work in readiness for machining the metal to shape. All machine work on the tools is done on special machines, such as turning, jig-boring, grinding, slotting, etc. This machining has to be done with great accuracy, but the degree of precision required will vary according to the particular job. For certain parts of the tool a limit of one-thousandth part of an inch is near enough; for others it may be necessary to work to the extreme fineness of one ten-thousandth part of an inch!

The tool-maker now fits all the parts together, after which they are ready to be heat-treated to give the steel its maximum

ability to resist the particular strains and stresses to which it will be subjected in operation. The heat treatment varies considerably, according to the grade of steel used in the tool and the result desired from the treatment. Carbon and alloy steel tools are hardened right through by raising them to a given degree of heat—780°C. for carbon steel, 1,000°C. for alloy steel—in either a gas, electric or salt bath furnace. Immediately the tools are brought from the furnace they are cooled rapidly by immersion in a water or oil bath. The tool is heated a second time to temper the steel to a given degree, the temperature employed in this operation being varied according to the degree of temper required. It is rare for any greater degree of temperature than 300°C. to be required in this process. The tempering process lowers the hardness of the steel to working requirements.

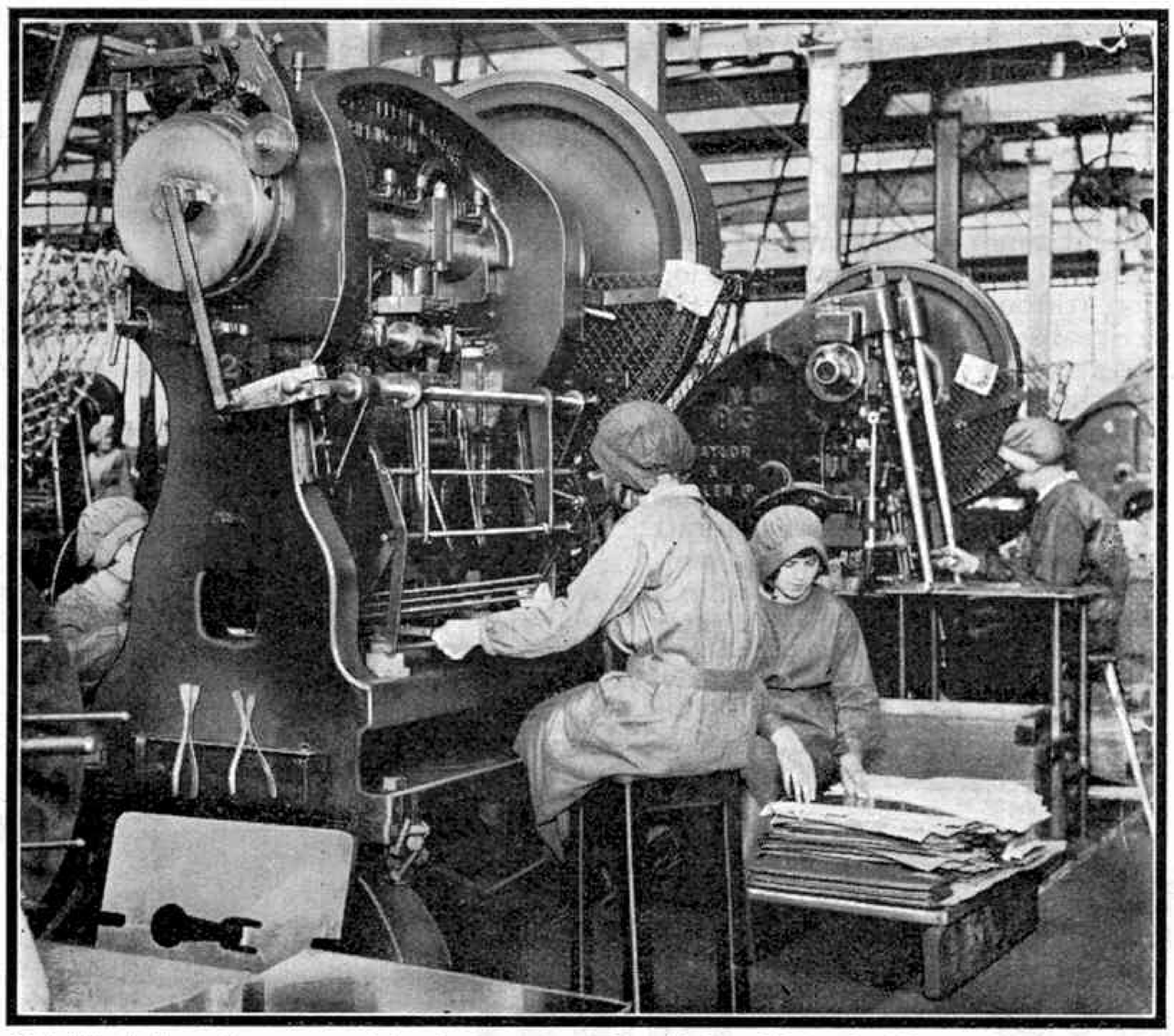
Mild steel cannot be hardened in this way, as the carbon content is too small; but the surface of the metal can be hardened if treated by a process known as "carbonisation." This process varies according to the size of the part and the depth of hardness required. Small parts are submerged in a bath furnace of cyanide with a working temperature of 1,000°C., and then quickly cooled in water. Large parts are packed in metal boxes with a carbonising mixture (bone and charcoal, etc.) and are raised to the required degree of heat in a furnace in which they remain for a time that will vary according to the depth of hardness required, six hours being a normal period to secure hardness to a depth of 1/16th of an inch. The cooling process, known as "quenching," is carried out by immersing the parts in water as in the case of small parts.

After hardening, all cutting parts of the tool are ground. The tool is completely re-assembled and is now ready for the necessary tests that must be carried out before the tools are passed to the Production Departments for use.

While the work of preparing the tools has been going on, the estimating staff have been busy ascertaining the quantities of materials required in the production of the order. These materials must be ordered from the makers and be in the Stores ready for issue to the Production Departments immediately the tools are completed. Another section orders the necessary packing materials and the cartons in which the articles are to be packed.

The Raw Material Stores provides the visitor with a vivid impression of the wide range of the activities of the Factory. From 200 to 300 tons of steel, brass and tinplate are maintained as a floating stock. The strip steel used for Meccano parts is stacked in coils weighing approximately ¾ cwt. each, and ranging in width from ½ in. upward, according to the part to be made from them. The ½ in. size is used for 12½ in. Meccano Strips, which are stamped from the strip longitudinally. The sizes from 5½ in. downward are blanked from wider strips, the width of the strip varying according to the length of the part to be stamped from it.

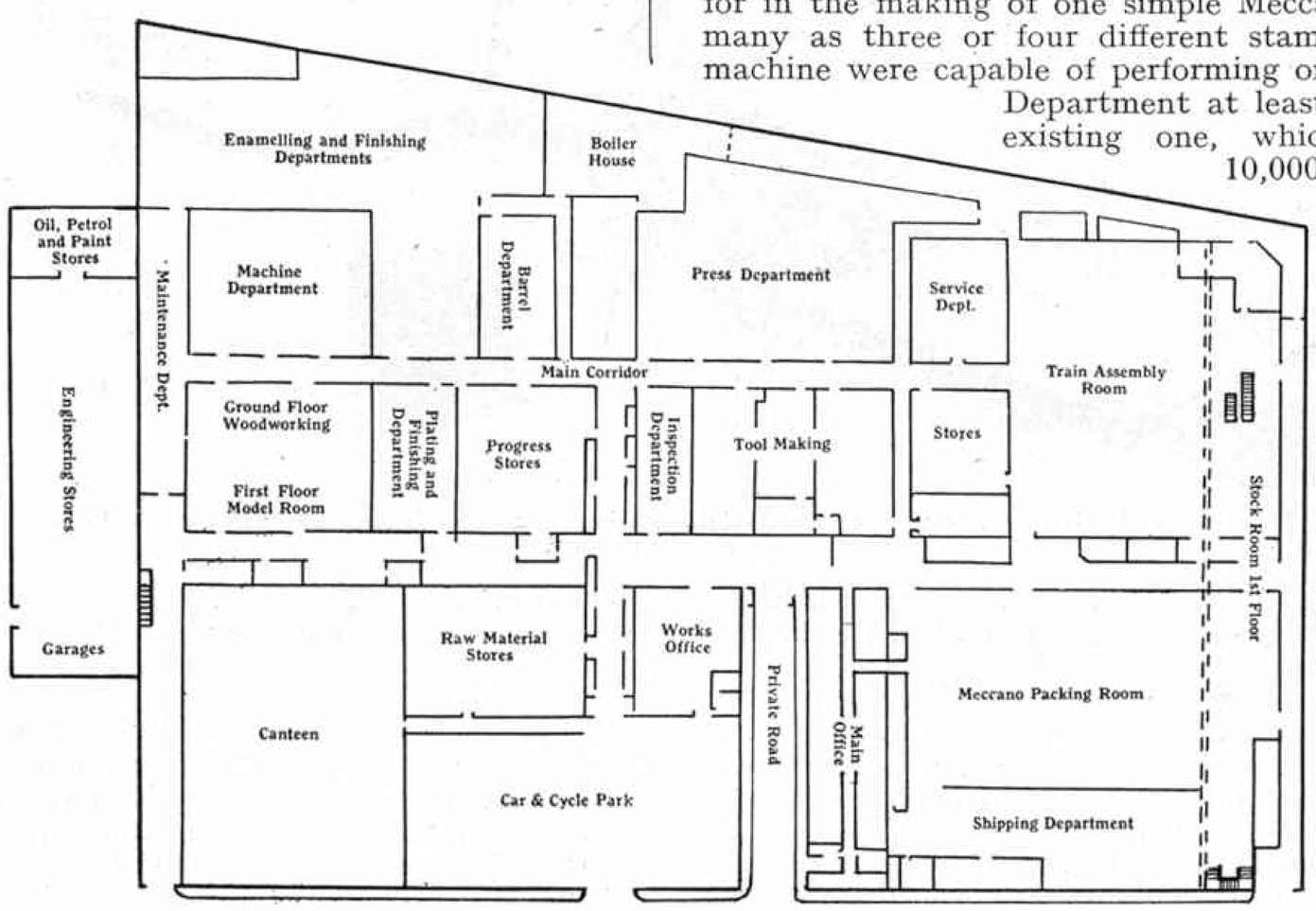
Perhaps the most interesting material is the tin-plate used for Hornby products. This is packed in boxes and varies in thickness or gauge according to the job for which it is intended, the heaviest sheets being those used for the boilers and framings of the No. 2 Special and No. 3 classes of locomotive. The greater part of the material is plain, the colouring and design being applied by spray-painting and transfers, processes that will be described in a later article.



This illustration shows one of the larger presses described, a 70-ton double-crank power press, fitted with one of the latest safety devices to safeguard the operator's hands.

When the tools are completed and the raw material is assembled, the processing passes into the hands of the Progress Department the work of which is to supervise the actual production. How involved this work is may be realised from the fact that there are 560 individual parts in a No. 2 Special Train Set. The production of all the parts required for any particular job must be kept running simultaneously so that they may reach the Progress Department Stores together in readiness for assembly. Any delay in regard to any one part would cause a serious hold-up of the whole product.

The first of the Production Departments is the Press Department, where there is a range of presses. Hand-operated presses carry out the lighter classes of work, while the heavier power-driven machines perform the heavier and more complicated work. An interesting feature is that each machine can be adapted to perform any stamping job within the limits of its capacity, by the insertion of the appropriate tools. This interchangeability is an essential feature, for in the making of one simple Meccano part there may be as many as three or four different stamping operations. If each machine were capable of performing only one operation, a Press Department at least 10 times the size of the existing one, which covers approximately 10,000 sq. ft., would be necessary. Not all the machines in the department are presses; other machines include a number of guillotines used for shearing tinplate sheets to required dimensions in readiness for blanking operations.



This plan of the Meccano Factory will help readers to follow the progress of a Meccano part in the course of manufacture, as revealed in this and the succeeding articles. The plan is interesting to study in conjunction with the aerial view published in the March "M.M."

As a typical example of the working of the department we may take the making of a Flanged Plate. The blanking, piercing of the equidistant holes, and flanging, involves three operations in three power presses, working at a pressure of from 20 to 30 tons. In the first operation the plates are blanked from a coil of steel, the coil being placed on a coil holder, and its end fed into the machine. The top or blanking tool is shaped like the plate, with its flanges laid flat. This part of the tool is fixed to the ram of the press. The bottom portion or die of the tool is of hardened alloy steel, and has a correspondingly-shaped hole cut out, so that the two parts of the tool fit exactly one into the other. The bottom part of the tool is fixed to the bed-plate

(*Continued on page 818*)

Meccano Aerial Bombing

An Exciting New Game of Skill

ONE of the most powerful and destructive military weapons that have been devised in recent times is the bombing aeroplane. Those who have witnessed a raid on an ammunition dump, aerodrome, or field position (through the medium of the cinematograph screen !) will at once realise the tremendous amount of destruction a successful bombing attack is capable of inflicting, and the overwhelming advantage that the user of the air has over those stationed on the ground.

The operator of a bombing machine does not have matters all his own way, however, as science has not been slow to devise methods of repulsing the bomb-laden aeroplane. Anti-aircraft guns, firing time-exploded shells to great heights, prove a considerable menace to the bombing machine, especially if a " dose " of shrapnel finds its way into the petrol tank ! High-speed fighter machines armed with as many as six machine guns are used to pour death into the attacking bombers, and these machines possess the advantage of being much more easily manœuvred than the comparatively slow and heavy bombing craft.

Apart from the chance of failure due to a counter-attack, the actual hitting of the required target is by no means an easy task, and calls for a considerable amount of skill on the part of the aircraftsman. When the bomb is released, the machine is travelling at high speed (perhaps 100 m.p.h.) and the bomb consequently will not drop downward in a straight line, but will follow a slightly curved path in the direction in which the machine is travelling. This factor, together with the height of the machine above its objective and the weight of the bomb itself, have to be taken into account if a direct hit is to be made.

It is to be hoped that Meccano boys will never be called upon to demonstrate their prowess in releasing death from actual military aircraft. By building the model Aerial Bomber described in this article, however, they may carry out some exciting " bomb dropping " in miniature, and with a little practice may become expert target hitters, even when the model bombing machine is travelling at high speed !

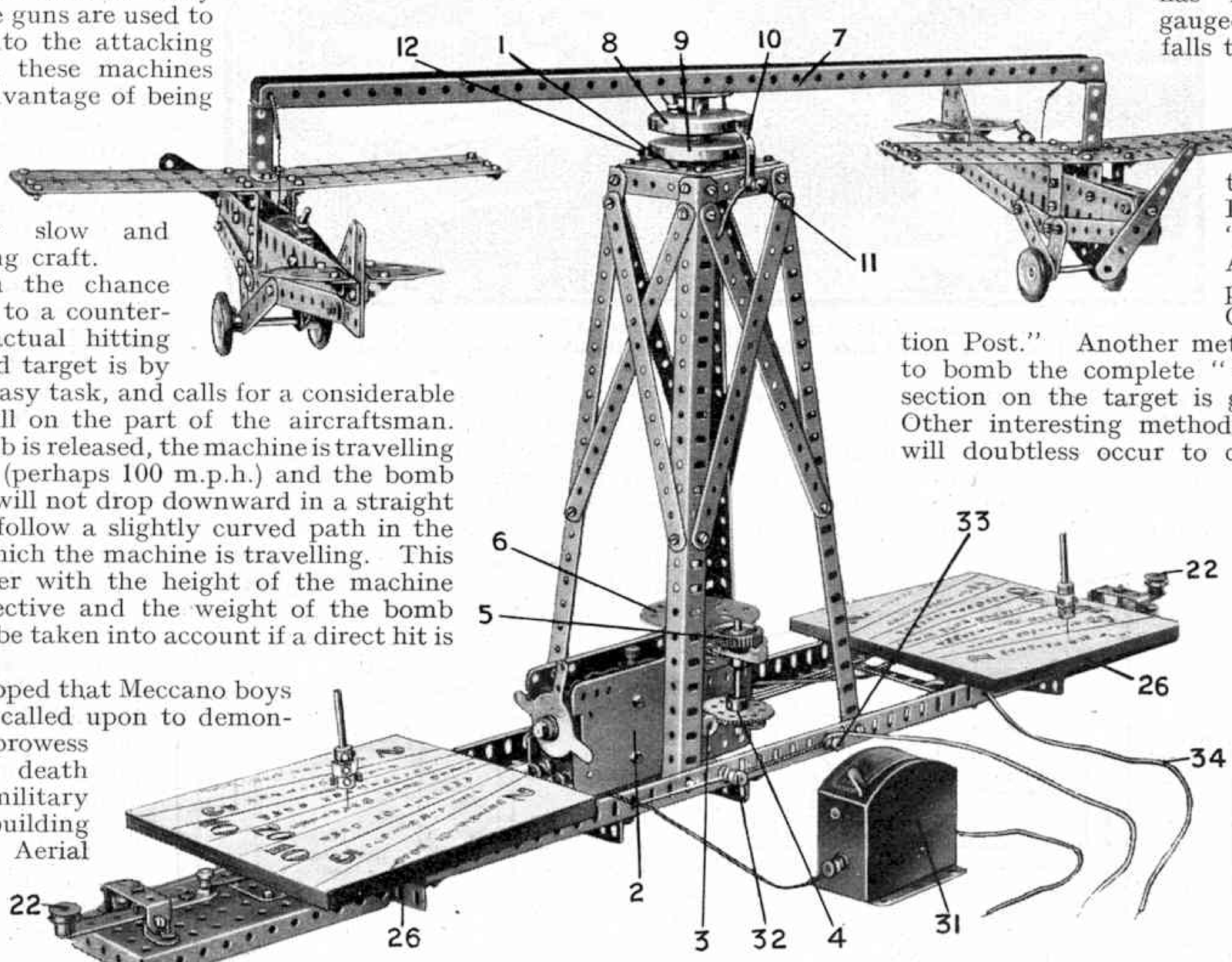


Fig. 1. General view of the Aerial Bombing Game, showing rotary collector and Motor gearing.

The Aerial Bomber forms an exciting game that may be played by two or more people. It is particularly suitable for use at a party, bazaar or similar function, and Meccano Club Leaders will find that the model will provide a great deal of excitement and amusement among members on Club Nights.

As will be seen from the general view (Fig. 1), the model consists of a vertical standard that supports a horizontal arm driven round by an Electric Motor. A model aeroplane is suspended from each end of the horizontal arm, and each aeroplane is fitted with an electric solenoid. The solenoids are connected to the Accumulator or Transformer operating the model through rotary current collectors, and when the current is passing the solenoids hold the " bombs " in position in the aeroplanes by magnetic force. The " bombs " consist of Axle Rods fitted with Octagonal Couplings. A switch key is fitted at each end of the framework of the model, and by depressing these keys the circuits between the solenoids and the current supply are broken. The solenoids are then no longer able to hold the bombs in position, and these fall from the fuselages of the aeroplanes.

Targets suitably marked are secured to the base-frame of the model in such a position that they are directly in the path of the revolving aeroplanes. By depressing the keys at the correct moment the bombs may be made to hit a section of the target, and a score registered.

The target numbers in the model have been marked out to represent the various strategic positions of a battlefield, and the greater the accuracy in operating the switch key bomb release, the higher the score registered. For example, if the bomb is released so that it drops on to the exact centre of the target, a direct hit on the " Field Head Quarters " has been made and 20 points are scored in consequence. If the releasing of the bomb has not been so accurately gauged, however, and the bomb falls to one side of the centre of the target, fewer points are scored, 10 points being obtained for hitting an " Ammunition Dump," five points for a " Field Howitzer " or " Anti-Aircraft Gun," and 2 points each for a " Machine Gun Nest " or " Observation Post." Another method of play is to attempt to bomb the complete " line," in which case each section on the target is given equal scoring value. Other interesting methods of arranging the target will doubtless occur to constructors.

The assembly of the model should be commenced by building the base-frame and centre vertical support. The base-frame consists of two 18½" Angle Girders spaced apart by means of 4½" Angle Girders and Strips. A 5½" × 2½" Flanged Plate is secured at each end of the base-frame and these Plates carry switch keys that will be described later. The vertical support is built up from four 12½" Angle Girders held together at the top by four 2½" Angle Girders. The 12½" Angle Girders are braced by means of 7½" Strips. A 2½" × 2½" Flat Plate 1 is secured in position on the top of the framework, and a Bush Wheel is bolted to the centre of this Plate to provide the top bearing for the vertical shaft.

The E6 Electric Motor 2 is secured to the 4½" Girders of the base-frame, and a Worm 3 is mounted on the armature shaft of the Motor. The Worm 3 engages with a 57-teeth Gear Wheel 4, mounted on a Rod that revolves in vertical bearings consisting of two Corner Brackets secured to the Motor side plates by means of 1½" Angle Girders. A 1" Gear Wheel 5 is mounted on the top end of the Rod, and this engages with a 2½" Gear Wheel 6 secured to the vertical shaft. The latter shaft consists of a 11½" Axle Rod, which is mounted at the top end of the frame in the Bush Wheel secured to the Plate 1, and at the base, in the boss of a Double Arm Crank that is mounted in between the Electric Motor side plates by means of Angle Brackets.

A Bush Wheel is secured on the top end of the Rod, and an arm 7 consisting of two 18½" Angle Girders, is attached to the Bush Wheel. Two insulated current collector discs 8 and 9 are also fixed in position on the upper end of the Rod, each disc being built up as

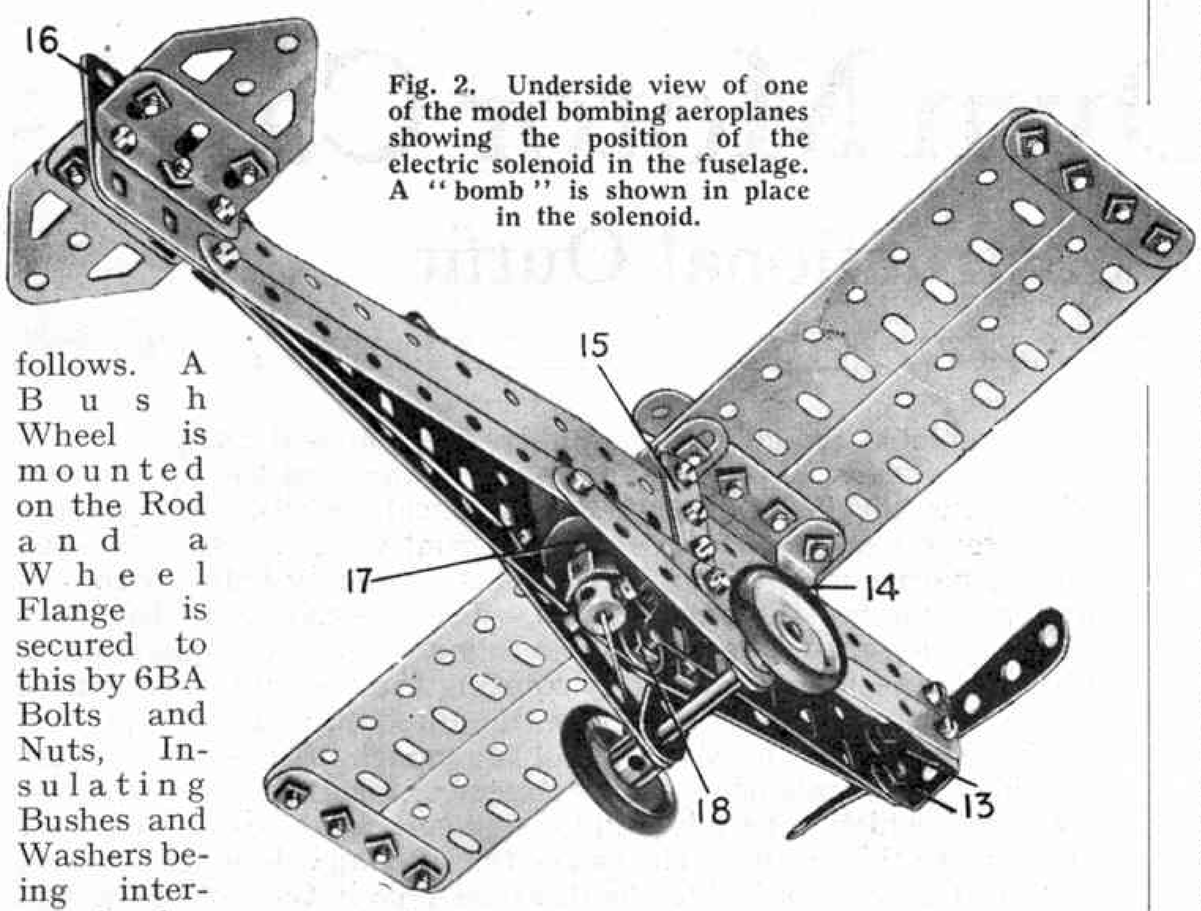


Fig. 2. Underside view of one of the model bombing aeroplanes showing the position of the electric solenoid in the fuselage. A "bomb" is shown in place in the solenoid.

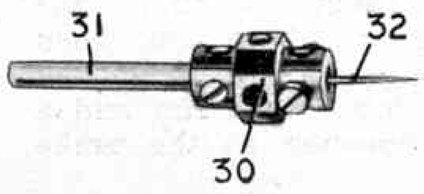
follows. A Bush Wheel is mounted on the Rod and a Wheel Flange is secured to this by 6BA Bolts and Nuts, Insulating Bushes and Washers being interposed between the faces of the Bush Wheel and the Wheel Flange, so that the latter is insulated electrically from the Bush Wheel. A second 6BA Nut is placed on one of the 6BA retaining Bolts, and this serves to form a connecting point for the insulated wire from one of the solenoids fitted in the aeroplanes. The brush 10 of the upper rotary collector is a Pendulum Connection (part No. 172), secured to the vertical frame of the model by means of a 6BA Bolt and Nut insulated from the frame by means of an Insulating Bush and Washer. A Terminal 11 is fitted to the 6BA Bolt so as to enable a length of flex to be attached. In the case of the Brush 12 at the far side of the model, this is assembled in a similar manner to the Brush that can be seen in the illustration, but the Pendulum Connection is bent into a "U" so that the tip of the connection may rub against the edge of the wheel Flange 9 as the latter revolves.

The Aeroplanes

The model bombing machines secured to the ends of the revolving arm 7 may next be assembled. Fig. 2 is an underside view of one of the machines with bomb in place. The sides of the fuselage of the model consist of two 9½″ Flat Girders held apart at the nose by means of two Double Brackets 13. The wing is composed of two further 9½″ Flat Girders held together by means of 2″ Strips. Two 1″×½″ Angle Brackets 14 and 2″ Strips 15 fitted with ½″×½″ Angle Brackets are used to support the wing in position. The tail planes are two Flat Trunnions held to the fuselage by means of 1½″ Angle Girders, and a Corner Bracket, and 1½″ Flat Girder 16 form the rudder.

The solenoid 17 that holds the bomb in place is assembled as follows. A Bobbin (Electrical Part No. 301) is wound full of No. 26 S.C.C. Wire (No. 313). The ends of the wire are passed through holes in the fibre cheeks of the Bobbin, and a strip of stiff brown paper is bound round the outside turns of wire and secured with Seccotine. The complete solenoid is then pushed into position between the Flat Girders forming the sides of the fuselage. One end of the wire is bared and secured under the Nut 18, while the other end is fastened to a length of insulating flex that passes along the arm 7 to one of the rotary collector discs.

Each aeroplane model is suspended from the end of the arm 7 by means of a 1½″×½″ Double Angle Strip.



The Switch Keys

The two switch keys may now be assembled and fitted to the base-frame. Each key is mounted on a 5½″×2½″ Flanged Plate (see Fig. 4). The key arm consists of a 3½″ Strip 20 secured to the Plate 19 by means of two 6BA Bolts and Nuts. The Strip is insulated from the Plate 19 by means of two Insulating Bushes and four Insulating Washers. A Terminal 21 is secured on the end of the shank of one of the 6BA Bolts, and a ½″ Fast Pulley 22 is mounted on the free end of the Strip 20 by means of a Bolt that is gripped by the Set Screw in the boss of the Pulley 22.

The stirrup 23 consists of a 1½″×½″ Double Angle Strip and two ½″×½″ Angle Brackets. It is secured to the plate 19 by means of 6BA Bolts and Nuts, Insulating Bushes and Washers being used to isolate the stirrup from the framework of the model. A ½″ Bolt 29 is fixed in position in the centre of the stirrup 23 by means of two Nuts. These Nuts should be adjusted so that the head of the Bolt 29 presses against the upper surface of the Strip 20. There is thus an electrical connection between the Terminals 21 and 24. When the Pulley 22 is depressed, however, the circuit is broken.

A 1½″ Angle Girder 25 is mounted on the Plate 19 and serves to support one side of the Designing Table 26 (see Fig. 1) forming the target board. The table is held in position by means of the ⅜″ Bolt 27, which is passed into the boss of the Bush Wheel secured to the base of the Designing Table, and gripped by the Set Screw in its boss. A Terminal 28 is mounted on a 6BA Bolt insulated from the frame by an Insulating Bush and Washer. A piece of Spring Cord about 4″ long is stretched between the Terminals 24 and 28. One end of a length of insulating flex is secured under the Terminal 28 and the other end of the flex is attached to one of the Terminals of the brush contacts 10 and 12. The Terminal 21 is connected to the corresponding Terminal at the other end of the model.

This system of wiring places the solenoid fitted in the aeroplane, the Spring Cord resistance, and the switch key in series with each other. The Spring Cord acts as a "blocking" resistance, preventing too great a current flowing in each solenoid circuit. Sufficient current must flow to energise the solenoids and enable them to hold the bombs; and if there is a tendency for the bombs to drop from the solenoids without the switch key being depressed it is a sign of insufficient current, and the Spring Cord resistance should be reduced slightly.

On no accoumt must the Spring Cord resistance between the Terminals 24 and 28 be removed entirely from the circuit. If this were done a very large current would flow, and damage to the Accumulator or Transformer might result.

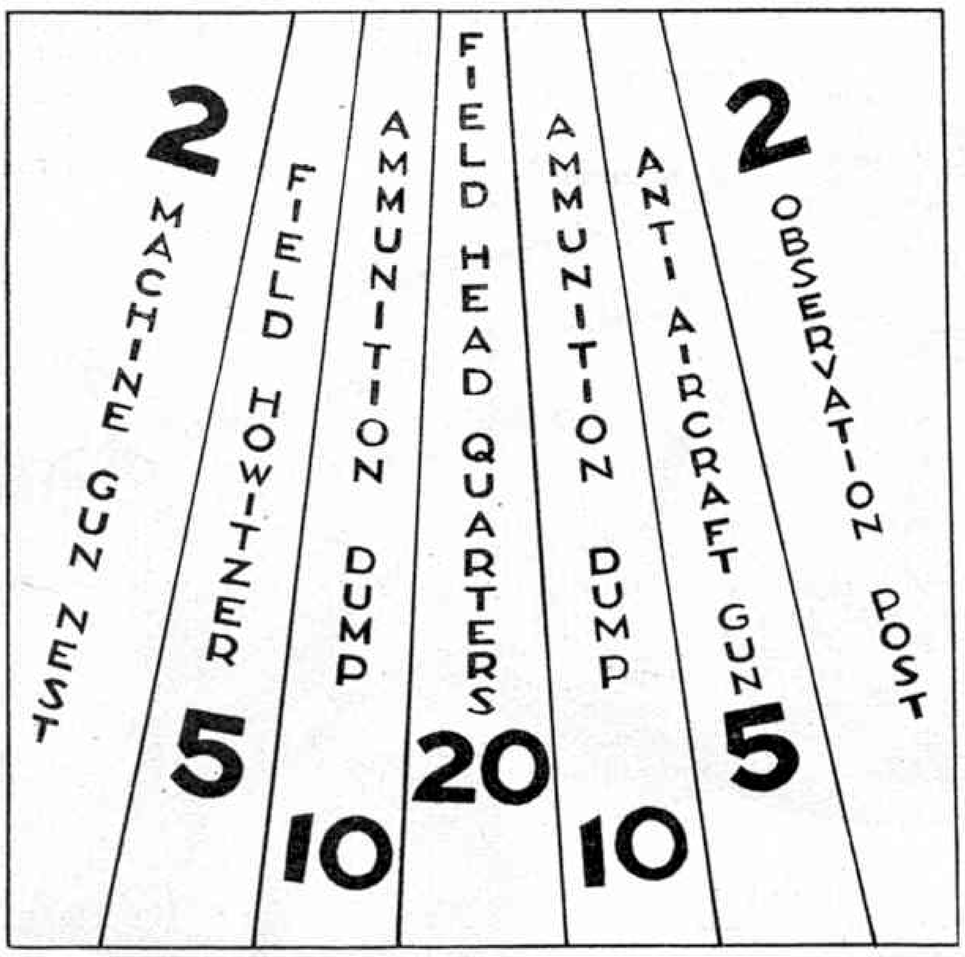


Fig. 3. How the scoring targets are marked out to represent a "battlefield."

The Bombs and Targets

The bombs that are used in the model are very simply constructed, and one is shown on this page. It consists of an Octagonal Coupling 30 fitted to a 1½″ Axle Rod 31. A short sewing needle 32 about 1″ long (a 'darning' needle broken in two will serve) is inserted in one end of the Coupling and held in a central position by means of two Set Screws.

The targets are merely sheets of stiff paper or card marked out as shown in Fig. 3 and afterwards attached to the Designing Boards 26 with a little Seccotine. In marking out the targets it should be noted that the dividing lines are radii of a circle having

(*Continued on page 770*)

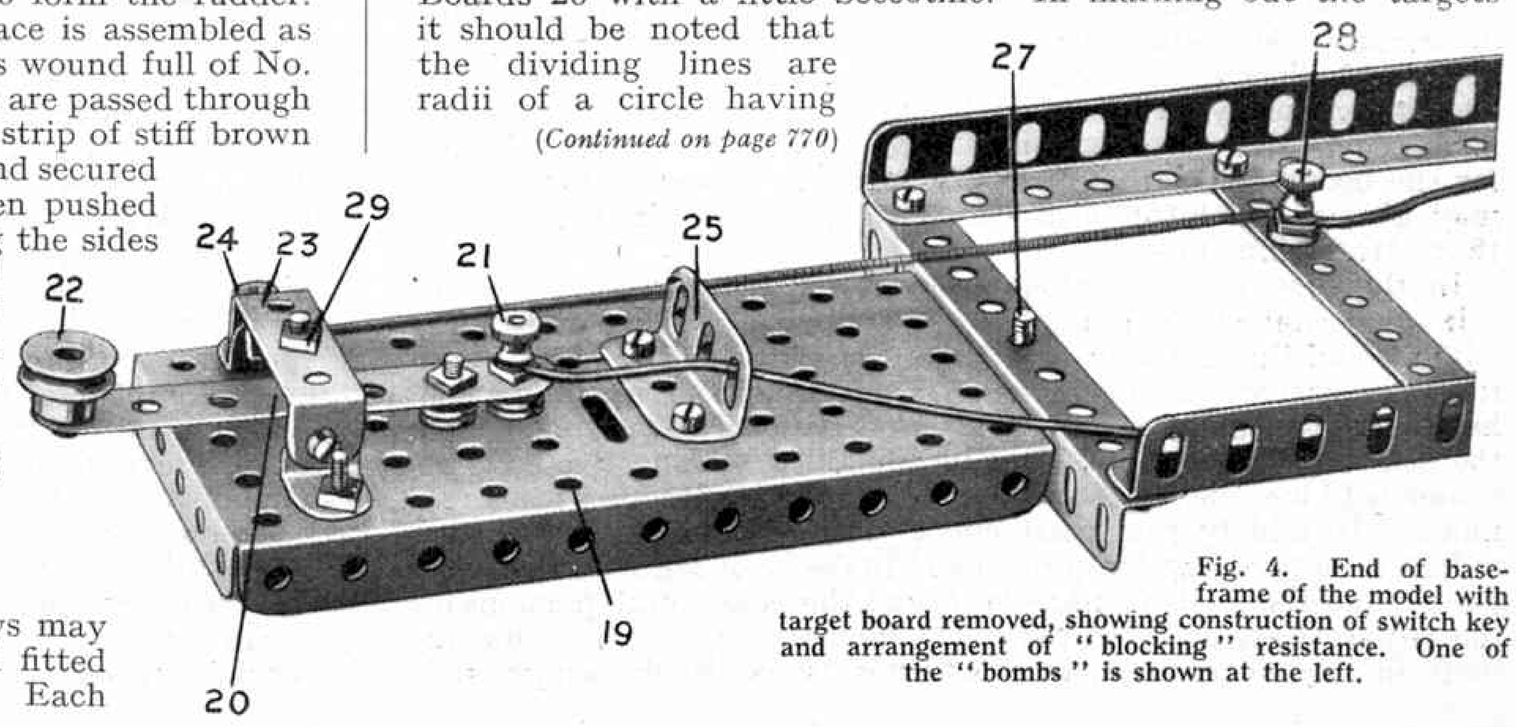


Fig. 4. End of base-frame of the model with target board removed, showing construction of switch key and arrangement of "blocking" resistance. One of the "bombs" is shown at the left.

Building Your Own Motor Cars!

The New Meccano Constructional Outfit

THE motor car is one of the most fascinating examples of modern mechanical development. The thrill of high-speed travel on road or track is rivalled only by the aeroplane, and the actual design and construction of a motor car provide an almost unlimited store of interest and education. Nowadays there are very few people who are not interested in some way in motor vehicles, and even those who do not actually own cars have a good idea of the principles on which they operate, and are able to pick out the best-known makes by noting their distinctive external features.

It is natural that cars should make a particularly strong appeal to Meccano enthusiasts, and their great popularity among model-builders is shown by the large numbers of cars that are submitted in every possible "*M.M.*" building contest. Meccano is splendidly adapted for building the chassis of a model motor vehicle, and the Meccano Chassis, Super Model No. 1, is a good example of the accuracy with which the mechanical features can be reproduced. The chassis does not by any means form a complete vehicle, however, for the bodywork and external features play an important part in the general scheme. Standard Meccano parts have certain limitations when employed for this purpose in model car construction, and for that reason there have been produced the Meccano Motor Car Constructor Outfits. These Outfits enable strikingly realistic models of sports and speed cars to be built—each one a masterpiece of design and workmanship.

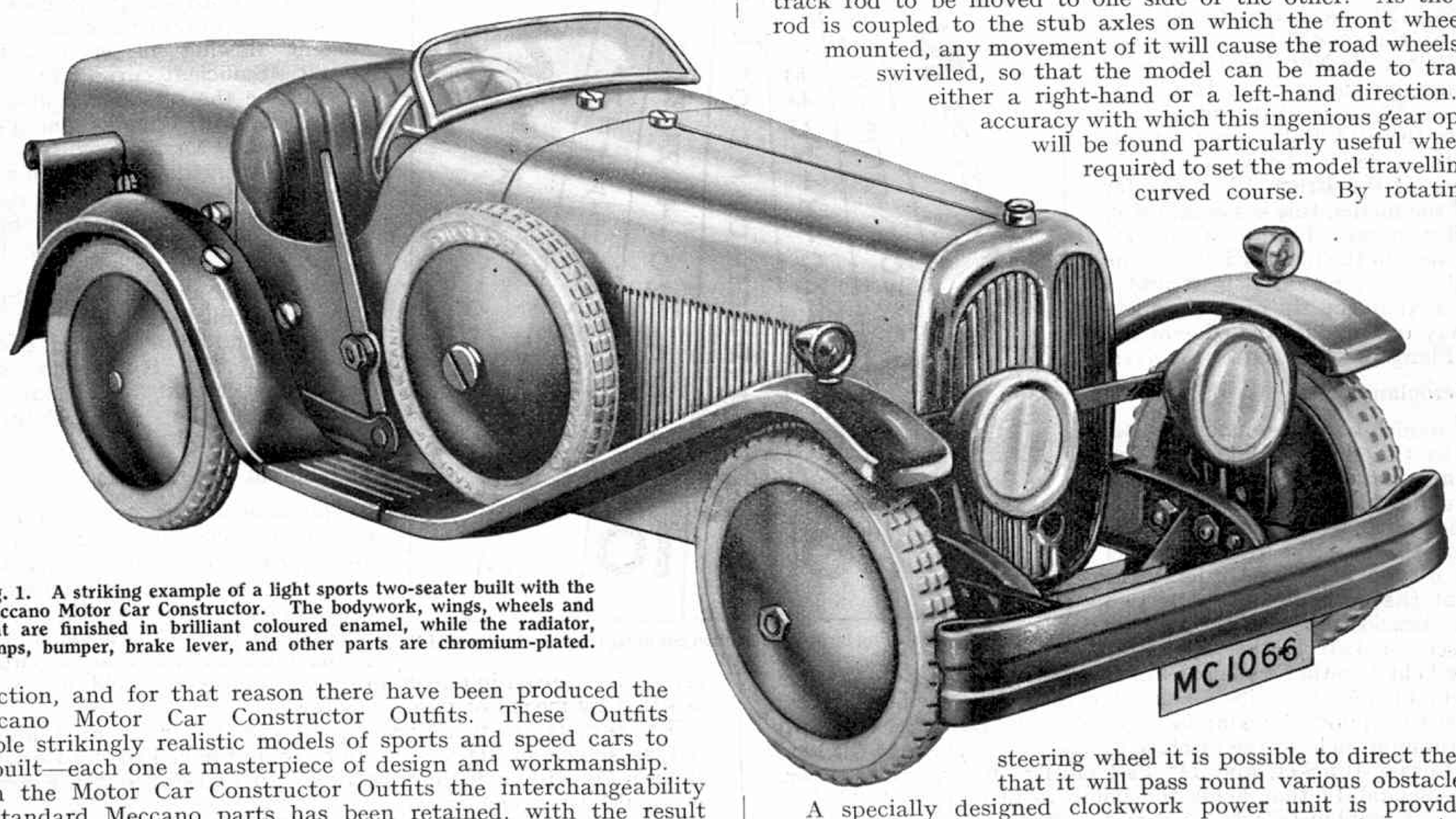


Fig. 1. A striking example of a light sports two-seater built with the Meccano Motor Car Constructor. The bodywork, wings, wheels and seat are finished in brilliant coloured enamel, while the radiator, lamps, bumper, brake lever, and other parts are chromium-plated.

In the Motor Car Constructor Outfits the interchangeability of standard Meccano parts has been retained, with the result that the builder can vary his designs according to his own ideas. The individuality of the models thus made possible is further increased by the introduction of three distinctive colour schemes for the bodywork of the models, so that the model motor builder may obtain an Outfit with which to build cars in the colours that attract him most.

In the first of these colour schemes the bodywork of the car is in green enamel, the mudguards and running boards are in cream enamel, and the seat is in bright red " crackle " lacquer that gives it a very leather-like appearance. The second colour combination has the bodywork of the car in brilliant red, the wings cream, and the seat section in blue; and in the third scheme the body is enamelled blue, the wings are cream, and the seat section has a red finish. To add to the smart effect of these colour schemes, the radiator, bumper bar, lamp rings and brake lever are all chromium-plated, and the realistic disc wheels and the honeycomb portions of the radiators are coloured red. The appearance of a Meccano car built in any of these colour schemes is extremely smart and the completed model is remarkably like the real thing!

We must now leave the external appearance of the cars to deal with some of the outstanding mechanical details. Ackermann-type steering gear is provided for the front wheels, with worm and nut actuating mechanism, and there is a strongly built clockwork motor drive for the rear wheels. The steering gear has been carefully designed to enable an extremely delicate adjustment of the front wheels to be made by rotating the steering wheel placed in the dash. The front wheels are mounted on stub axles pivoted to the sides of the chassis frame of the model. The stub axles are provided with extension arms connected together by means of a track rod, which in turn is coupled to a bell crank with a nut block attached to this crank. The end of the steering column is threaded so that it may work inside the threaded hole in the nut block, and thus there is obtained in the Meccano car a very close copy of the worm and nut gear that is used on many actual cars.

When the steering wheel is rotated the threaded end of the steering column draws the nut block up or down, and consequently the bell crank to which the nut block is attached is actuated. The bell crank carries a pin that engages with a slot in the centre portion of the track rod, and movement of this pin causes the track rod to be moved to one side or the other. As the track rod is coupled to the stub axles on which the front wheels are mounted, any movement of it will cause the road wheels to be swivelled, so that the model can be made to travel in either a right-hand or a left-hand direction. The accuracy with which this ingenious gear operates will be found particularly useful when it is required to set the model travelling on a curved course. By rotating the steering wheel it is possible to direct the car so that it will pass round various obstacles.

A specially designed clockwork power unit is provided for the Meccano car models, the clockwork mechanism being produced on similar lines to the famous mechanisms that have contributed so largely to the world-wide success of Hornby Trains. This motor, however, has been designed with special regard to the particular requirements of a model racing car, and it incorporates a spring that gives a remarkably powerful drive at high speed, together with an exceptionally long run. When fully wound the motor drives the car for a distance of 150 ft. at a scale speed of approximately 100 m.p.h.!

Another interesting mechanical feature is the brake mechanism. This is of the internal expanding type, and is controlled by means of a brake lever mounted on the outside of the body at the right-hand side of the dash. The mechanism of the brake is particularly ingenious, and it provides an effective braking action on the clockwork motor while the latter is being wound up, and when the car is required to be kept at rest on the ground.

The brake gear consists of a drum having a split rim and a special tapered cam that is pivotally connected to the brake

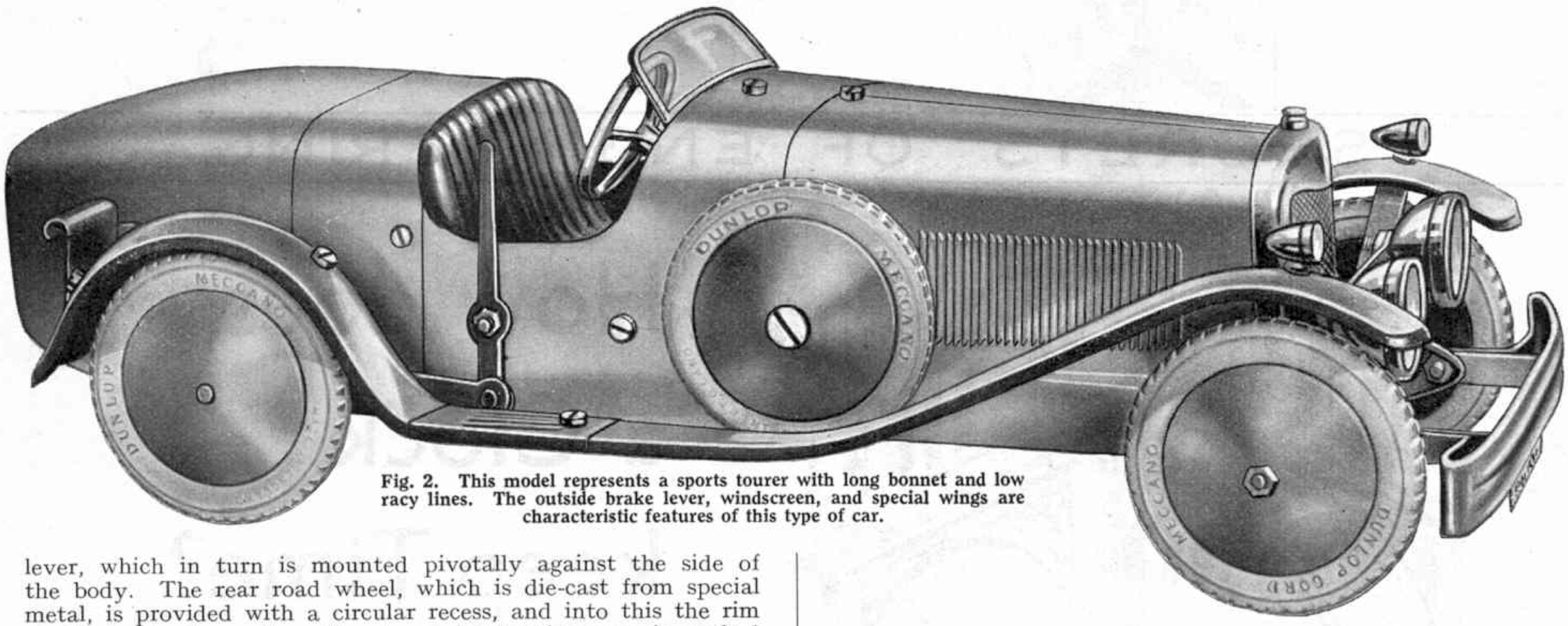


Fig. 2. This model represents a sports tourer with long bonnet and low racy lines. The outside brake lever, windscreen, and special wings are characteristic features of this type of car.

lever, which in turn is mounted pivotally against the side of the body. The rear road wheel, which is die-cast from special metal, is provided with a circular recess, and into this the rim of the brake drum fits. The tapered actuating cam is pushed into position between the split rim of the drum, and the control lever is arranged so that when in the forward position the brake is "off." To apply the brake the lever is drawn back, and the tapered cam then comes into action and forces the split rim of the brake drum outward. The rim then makes contact with the circular recess in the rear wheel and the friction results in a powerful braking action.

The addition of correct-type steering and braking mechanisms enables a series of interesting operations to be carried out when preparing the model "for the road." The brake lever is first of all drawn back so that the brake is applied fully. The clockwork motor is now wound up by means of the key provided, and the complete car is placed on the ground. If the car is desired to travel forward in a straight line, the steering wheel is rotated so that the front wheels are exactly in line with the rear pair; while movement of the wheel to either the right or the left will result in the car describing a curved path in its run. After the steering has been adjusted the brake lever is moved into the forward position, thus releasing the rear wheels, and the car will then move off gradually, gathering speed until it is "flat out"! The car will travel at speed for the full 150 ft. The best results as regards speed and length of run are obtained when the model is run on a concrete, tar macadam, or other surface that is both smooth and hard.

Turning once again to the external fittings and features of the cars, it will be noticed that two distinct types of radiators are included. These are interchangeable, so that either may be fitted to the model as required. The radiator fitted to the car shown in Fig. 1 is of graceful modern design. It has curved sides, and a "centre line," which is an outstanding feature in the design of actual modern radiators. The radiator incorporated in the car shown in Fig. 2, on the other hand, has parallel sides, and the general sturdy lines of the powerful British speed car that the model represents. Two types of rear body section are also supplied, one being of the rounded pattern as shown in Fig. 2, and the other of graceful streamline tapered type, Fig. 3. The wheelbase and overall length of the car can be altered as required. The car shown in Fig. 1 is a short wheelbase type, while the models illustrated in Figs. 2 and 3 have long wheelbases.

Another very interesting variation in the arrangement of the Constructor parts is in building a light six-cylinder speed machine. Modern racing cars are classified in accordance with the total cubic centimetre capacity of the cylinders of the engine. The "baby" M.G. Midget thus comes in the 750 c.c. class, which means that its engine has a total cylinder capacity of 750 cubic centimetres. Many light racing machines, however, have engines with capacities between 1,000 and 1,500 c.c.

Popular British cars in the "light racer" class are the Riley, Fraser-Nash and the Aston-Martin. Among the famous French cars of this type are the Amilcar, Salmson, and Buggatti, while numerous light racing cars are manufactured by Italian, German, and other Continental concerns.

It is possible to build a very realistic model of this kind with the Meccano Motor Car Constructor Outfit. Unfortunately it has not been possible to include an illustration of this model here, but it may be said that the model incorporates many of the features of a real light racing machine and is of the short wheelbase type.

Full constructional details for building each of the fine models mentioned in this article are contained in a new Instruction Manual included in each Motor Car Constructor Outfit. The constructional details are made clear by means of numerous illustrations, so that no difficulty should be experienced in reproducing any of the models described.

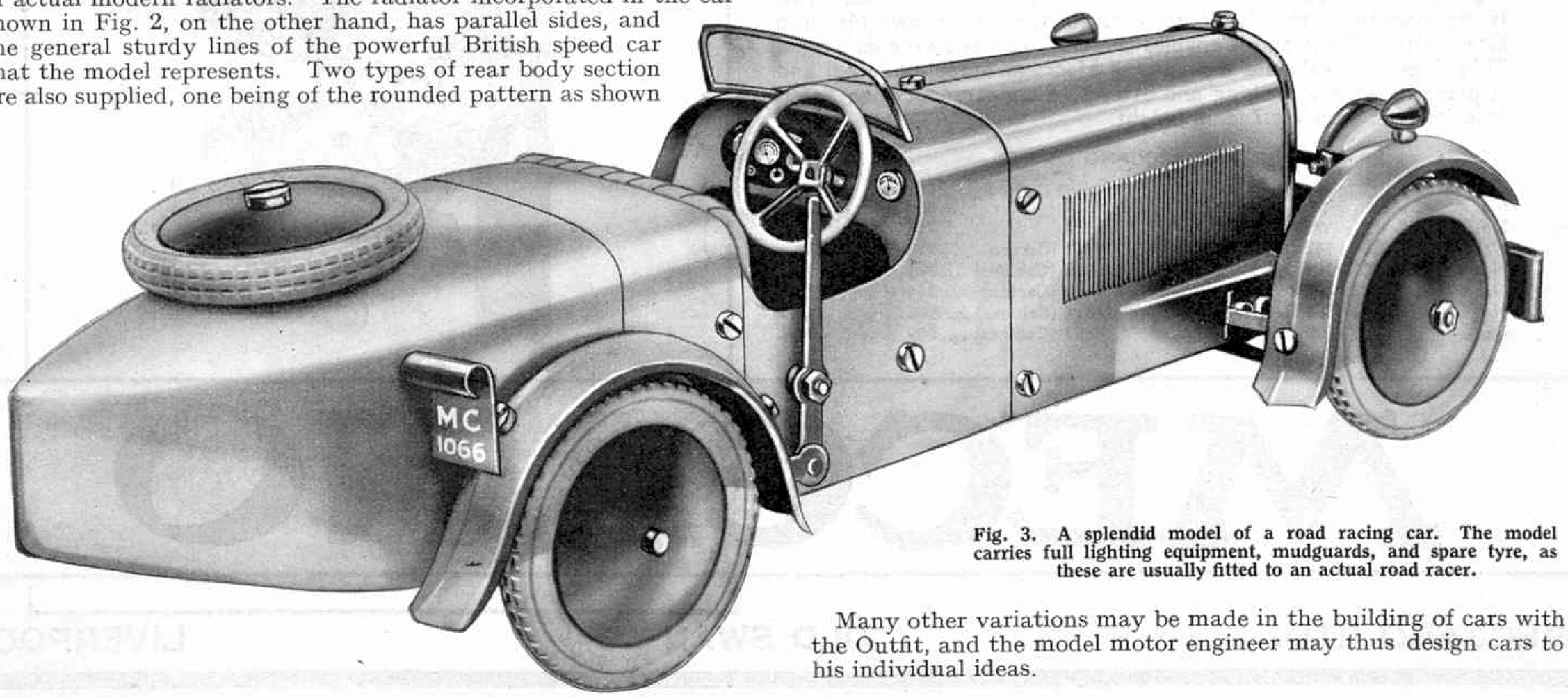
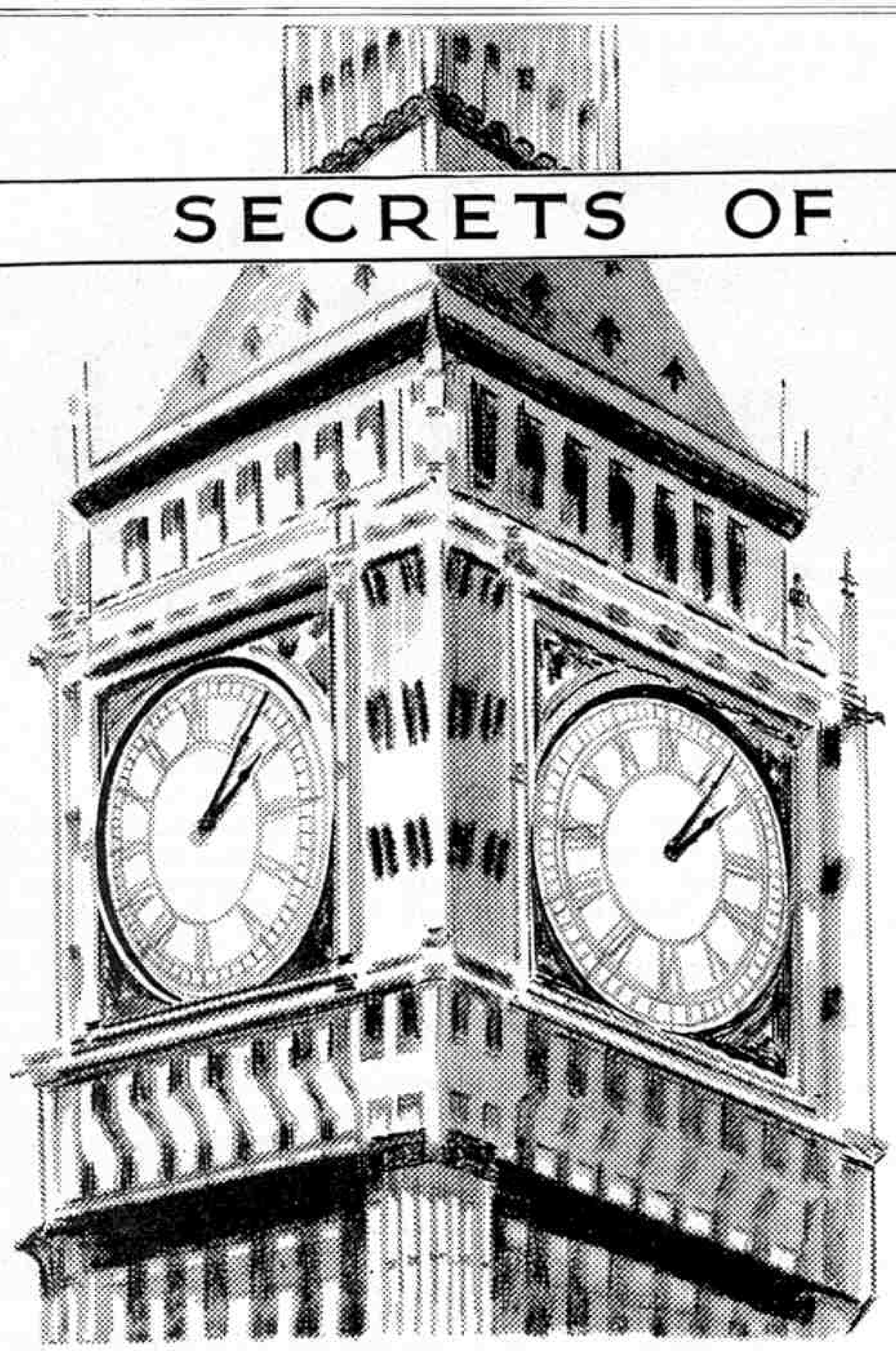


Fig. 3. A splendid model of a road racing car. The model carries full lighting equipment, mudguards, and spare tyre, as these are usually fitted to an actual road racer.

Many other variations may be made in the building of cars with the Outfit, and the model motor engineer may thus design cars to his individual ideas.

SECRETS OF ENGINEERING



How does a Clock keep Time?

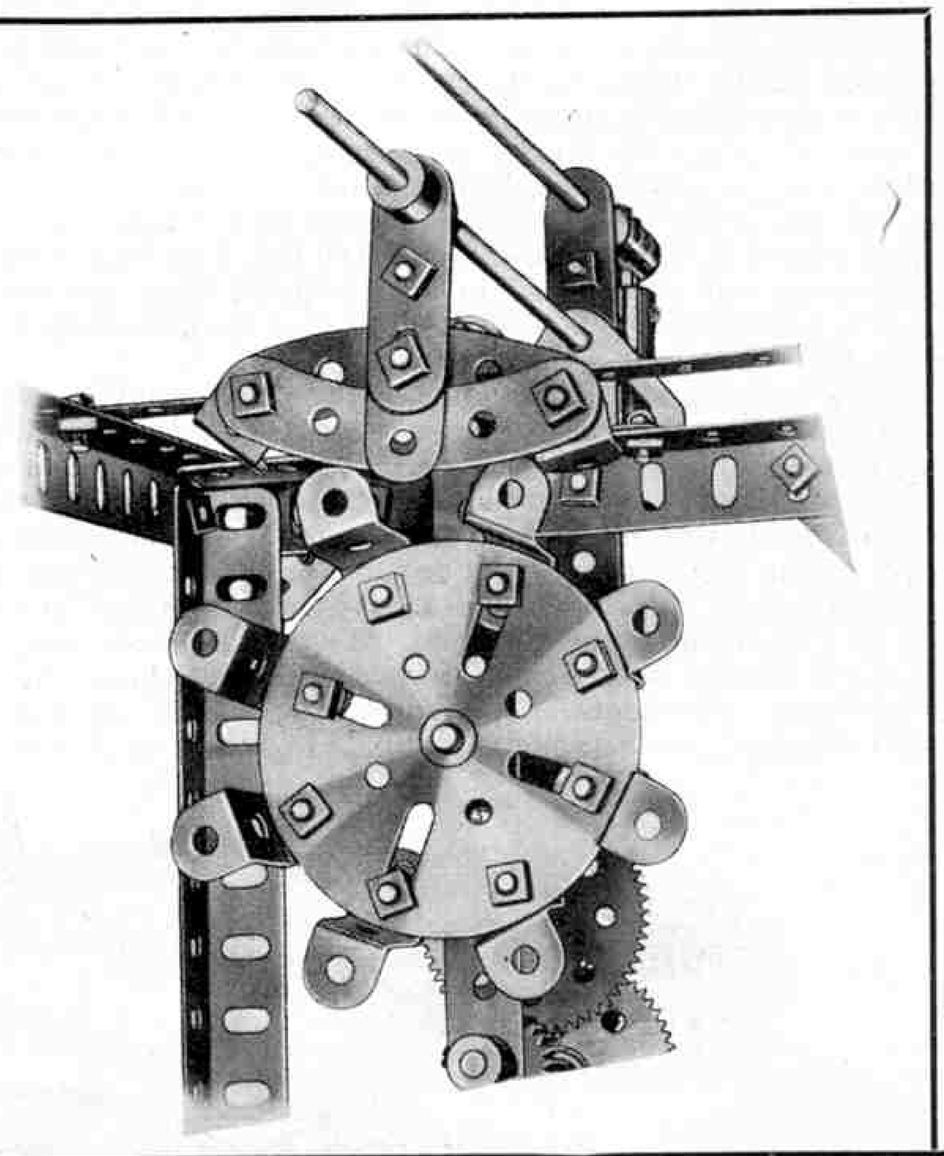
Full instructions for building a complete Meccano Grandfather Clock are contained in the special Instruction Leaflet No. 14A, obtainable from any Meccano dealer price 2d., or direct from Meccano Ltd., Binns Road, Old Swan, Liverpool. Price 2d. post free.

Every modern clock, from the smallest household type to great turret clocks like "*Big Ben*," depends for its accurate time-keeping upon some form of regulating mechanism. Many types of such mechanisms have been devised, but the most widely used and the most reliable consists of a pendulum acting through a pallet and an escapement wheel. The operation of this device is based on the property possessed by a pendulum of always swinging at a constant rate, and thus providing a regulating influence that is transmitted to the clock movement.

The lower illustration on this page shows how perfectly this ingenious arrangement can be reproduced in Meccano. This is the mechanism that is incorporated in the well-known Meccano Grandfather Clock, and it enables the clock to keep excellent time. This clock is a splendid example of Meccano model-building, and it presents a very striking and attractive appearance when fitted into its case, which is 7 ft. in height.

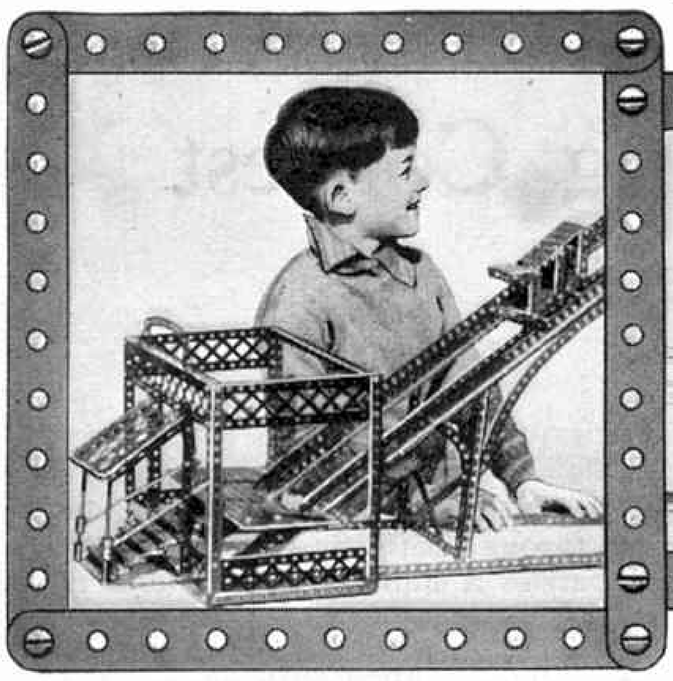
PRICES OF MECCANO OUTFITS

Outfit	Builds	Price	Outfit	Builds	Price
No. X1	70 models	1/3	No. 3	687 models	27/6
No. X2	96 ,,	2/–	No. 4	753 ,,	52/6
No. 000	162 ,,	2/6	No. 5 (Carton) ...	798 ,,	70/–
No. 00	189 ,,	3/6	No. 5 (Cabinet) ...	798 ,,	100/–
No. 0	343 ,,	5/–	No. 6 (Carton) ...	844 ,,	125/–
No. 1	573 ,,	10/–	No. 6 (Cabinet) ...	844 ,,	155/–
No. 2	629 ,,	16/–	No. 7 (Cabinet) ...	889 ,,	450/–

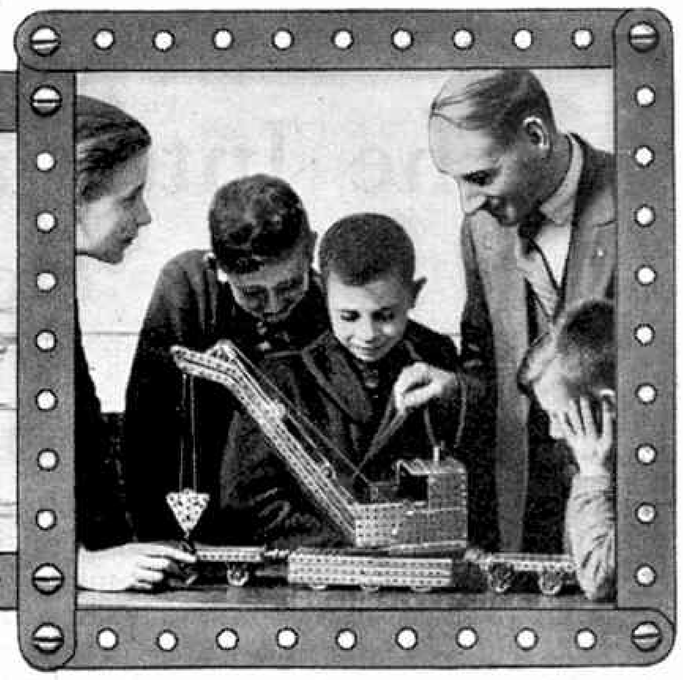


MECCANO

MECCANO LTD. OLD SWAN LIVERPOOL



WITH THE MODELBUILDERS



FITTING THE MECCANO AERO MOTORS

Since the introduction of the special clockwork motors for fitting to Meccano Aeroplane models, many owners of aeroplane outfits have added either a No. 1 or a No. 2 Motor to their sets, and have in this way greatly improved the realism of their finished models. One or two model-builders have experienced slight difficulty in fitting the motors and getting them to run smoothly, and a few hints on the operation of the Aero Motors will therefore be useful.

The drive to the propeller shaft in the case of the No. 1 Motor, and to the Propeller and Landing Wheel shafts in the case of the No. 2 Motor, is by means of contrate and pinion gearing.

In order to obtain smooth running with either Motor it is important that the Pinion on the Propeller shaft meshes correctly with the teeth of the contrate. In the case of the No. 1 Motor assembly, the "pinion" on the propeller shaft consists of a number of vertical flutings cut into one end of the shaft itself. If the propeller shaft is arranged so that the contrate engages at the point where the flutings widen into the main shaft, smooth engagement cannot be obtained. It is important, therefore, to see that the Aero Collar, Part No. P52, is placed on the shaft so that the toothed end of the shaft is in the correct position. One or two experiments may be necessary before the best position can be obtained. These remarks apply also to the propeller shaft of the No. 2 Motor, but in this case the position of the Aero Collar on the shaft is even more important owing to the fact that the end of the shaft will fall out of its bearings in the Motor casing if too much play is allowed. The propeller itself should be secured against the front surface of the Fuselage Front, so that there is a slight amount of play between it and the Aero Collar placed against the inside surface of the Front Section. If excessive play is allowed there is a possibility of the grub screw of the Collar touching one of the bolts holding the Fuselage Front in place as the propeller shaft rotates. Inaccurate adjustment at this point may result in jerky running, or even in a complete locking of the drive transmission.

Like all other Meccano power units, the Aero Motors benefit considerably from careful lubrication. The Special Meccano Oil should be used for this purpose, the oil being applied to the gears and bearings with the Meccano No. 1 Oiler, or better still with the No. 2 miniature "K" type Oil Can.

THE SEMAPHORE PRACTICE DEVICE

We are constantly hearing from model-builders who have hit upon novel applications for Meccano, and we think the semaphore practice device constructed by Mr. F. E. Ross, of Kingsbridge, Devon, and illustrated in Fig. 2, will interest many readers, particularly if they are Scouts. As can be seen from the illustration, the device consists essentially of a vertical standard mounted on a wooden base so that the complete model may be placed on a desk or table. A short Rod is mounted in the top hole of the vertical standard and a Crank carrying a 5½" Strip is locked on the Rod. A Collar is next slipped on the Rod for spacing purposes, and a second 5½" Strip, to which is secured a disc of white cardboard is fitted in place. A Double Arm Crank is bolted in position behind the cardboard disc so that the boss will provide adequate purchase on the Rod. A Threaded Pin is attached to the disc to enable the complete disc and arm to be rotated easily.

A Bush Wheel is next fastened on the extreme end of the Axle Rod, and by rotating this the front arm of the semaphore is operated. To complete the model, short Strips are secured to the ends of the arms, each Strip being held in position by means of a bolt and two lock nuts.

The device is simple to operate and it provides an excellent means of practising semaphore signalling indoors. The operator rotates the semaphore arms, and those receiving instruction take the message spelled out in this way. Alternatively each member may take a hand at operating the device, by spelling out messages dictated by the instructor. Mr. Ross has used his Meccano semaphore in instructing the Kingsbridge Grammar School Wolf Cub Pack, and it has served its purpose remarkably well.

REVERSE MECHANISM

Drive changing and reversing gears provide interesting subjects for Meccano model-building, and many ingenious mechanisms have been devised by readers from time to time. Automatic reversing gears are particularly useful in demonstration models that are required to work continuously at exhibitions, club meetings, etc., and for work of this kind the gear must be as simple and reliable as possible.

Numerous reversing gears making use of Screwed Rods and pulley systems have been described in the "Suggestions Section," and when correctly adjusted they will function remarkably well; but for demonstration models that have to run for many hours on end, and where it is not easy to carry out adjustments, a really simple and "fool proof" mechanism is preferable. With care, even the simplest gear can be made to perform the required operations satisfactorily.

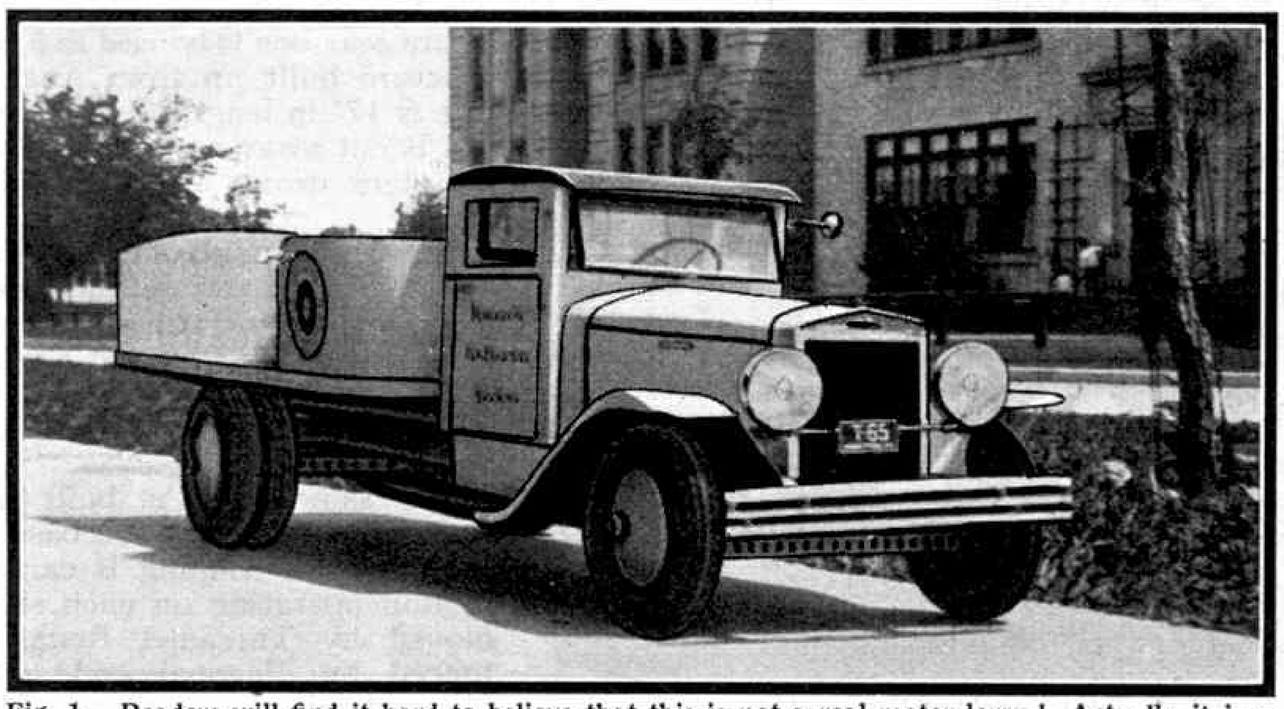


Fig. 1. Readers will find it hard to believe that this is not a real motor lorry! Actually it is a remarkably clever example of model construction and photography carried out by Norman B. Scott, of Winnipeg, Canada. The chassis is constructed entirely from Meccano, and cardboard and plywood have been used for the bodywork.

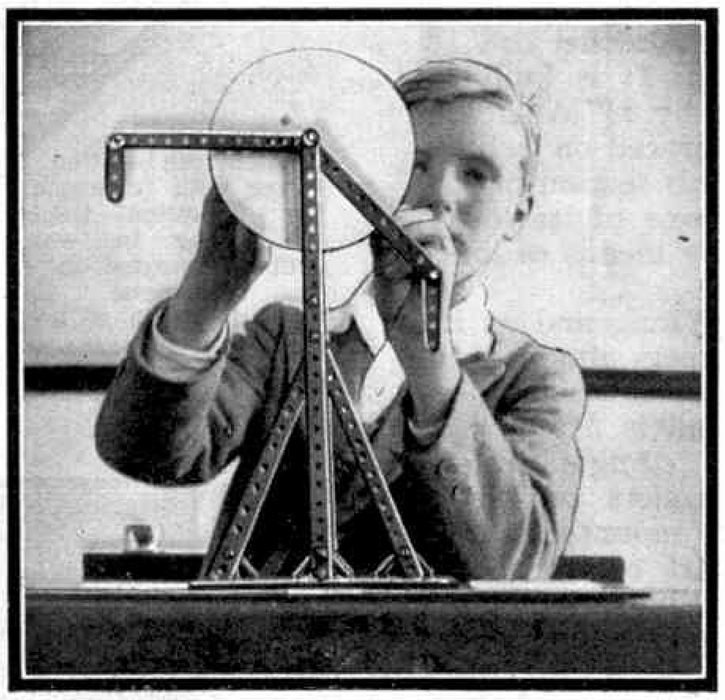


Fig. 2. Operating the Meccano Semaphore Practice Device described in the accompanying paragraph.

A good example of this is to be found in the large demonstration model of the Tower Bridge. This model, which was introduced last year, has a very imposing appearance, and the effect is increased considerably by the rising and falling action of the centre bascules. The bascules are actuated by means of a high-voltage electric motor that is coupled to the bascules through a simple cord and crank system. It is interesting to note that quite an elaborate reversing system was employed in the experimental version of this model, but this gear was discarded in favour of the cord and crank device owing to its greater reliability. In the Tower Bridge model the motor is coupled to a transverse shaft in one of the towers through spur and sprocket reduction gearing, so that when the motor is connected to the mains the transverse shaft rotates slowly. A Crank is mounted on one end of the transverse shaft and a length of cord is tied to the slotted hole in the web of the Crank. The cord is then passed up the inside of one tower and round a pulley at the top. It is then passed down the shaft, and finally is tied to a heavily weighted counterpoise on one of the pivoted bascules of the bridge. A block of lead is fixed to the end of each counterpoise so that when free the bascules tend to remain open, the lead weights drawing them into an almost vertical position. When the motor is started, however, the crank on the transverse shaft rotates and draws up the cord secured to the counterpoise, and the bascule is lowered into a horizontal position, whence the cycle of operations commence again.

The second bascule is coupled so that it works exactly in step with the first one. A second length of cord is attached to the crank and the cord is passed up the first tower and round the pulley at the top. It then passes along the walk-way that connects the two main towers, and round the pulley at the top of the second one. It is finally carried down the second tower and secured to the counterpoise of the second bascule. In order to synchronise the movements of the bascules, a means of adjusting the effective length of the second operating cord is provided. This consists of a length of screwed rod fastened to the counterpoise of the bascule. The operating cord is tied to an Angle Bracket that may be locked in any position on the Screwed Rod by means of two nuts.

NEW TAIL UNITS. We were interested in your suggestion that additional shapes of rudder unit and tail planes should be added to the Aeroplane Parts so that the empennage or tail assembly of the Meccano Aeroplanes could follow more closely those of different well-known types of aircraft. This is a good idea, but the drawback is that there are very many different styles of tail unit, and a very big range of parts would have to be introduced. The existing pattern of tail unit represents the general design of this portion of an aeroplane and it has quite a distinctive appearance. (*Reply to H. J. R. Cockayne, Walsall.*)

NEW BELL CRANK. A bell crank having arms 1½" and 1" long respectively might find some application, but it is not necessary to introduce a special unit for this purpose as it can be built up from existing parts. A standard Crank (Part No. 62) is first of all secured on a Rod and a 1" Corner Bracket (Part No. 133A) is then slipped on to the shaft, and bolted against the web of the Crank. This assembly will result in an unequal arm bell crank being formed that should suit your purpose admirably. (*Reply to T. D. S. Nichols, London, N.W.11.*)

RATCHET SPANNER. We have received many suggestions concerning a ratchet-type spanner, but while we acknowledge the usefulness of such an accessory, we fear that it would be very expensive to manufacture, and that its advantages would be outweighed by its cost. For most Meccano model-building purposes the present Meccano Spanner is quite suitable. (*Reply to R. Whiston, Newcastle.*)

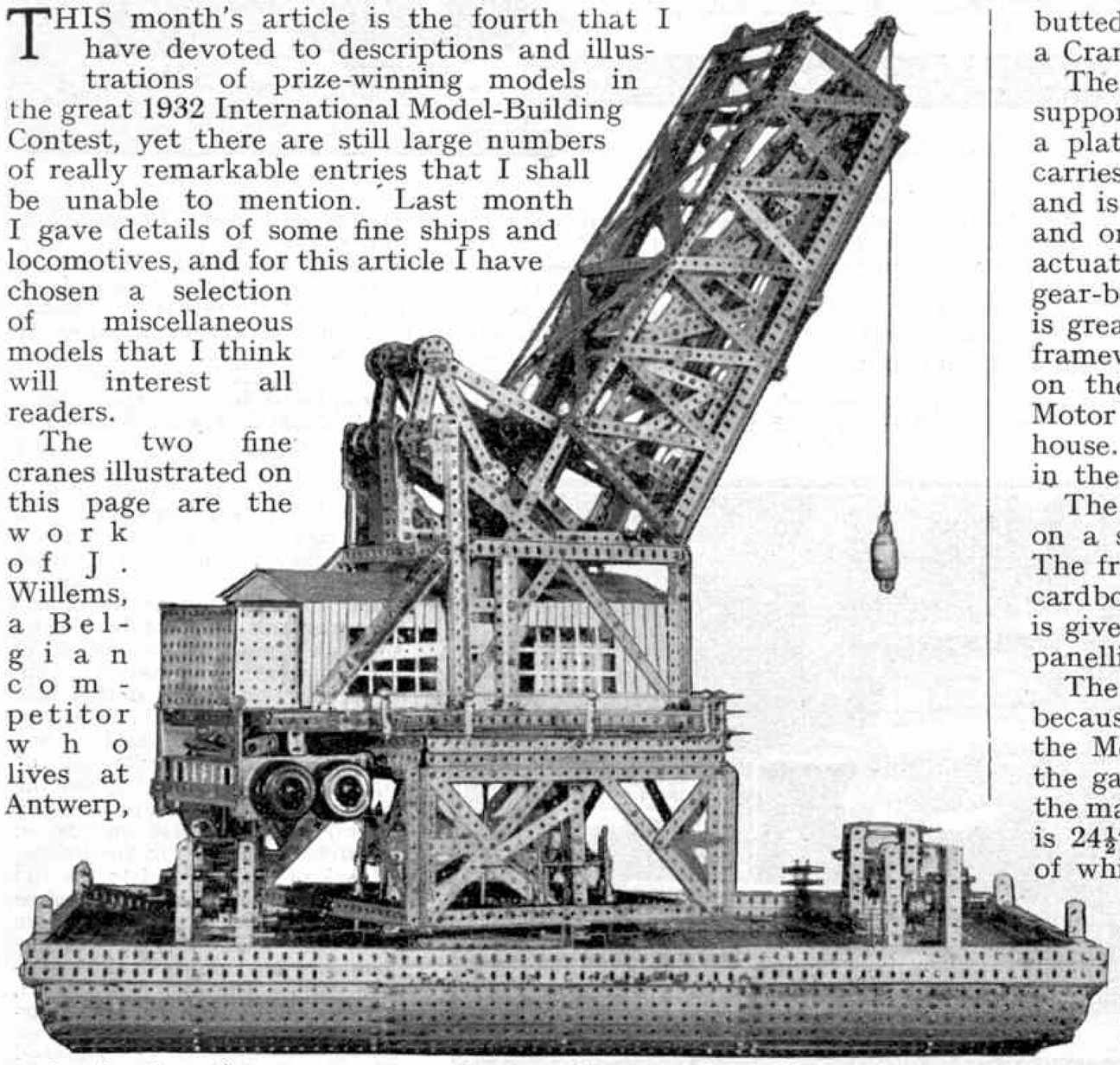
The International Model-Building Contest

More Wonderful Prize Models

By Frank Hornby

THIS month's article is the fourth that I have devoted to descriptions and illustrations of prize-winning models in the great 1932 International Model-Building Contest, yet there are still large numbers of really remarkable entries that I shall be unable to mention. Last month I gave details of some fine ships and locomotives, and for this article I have chosen a selection of miscellaneous models that I think will interest all readers.

The two fine cranes illustrated on this page are the work of J. Willems, a Belgian competitor who lives at Antwerp,



and who has for many years been a keen and enthusiastic Meccano constructor. The floating crane built by him is one of the finest models of its kind that I have ever seen, and is unique in being fitted with a collapsible or telescopic jib, so that it can pass under bridges. The model is capable of lifting considerable loads. One of the most interesting parts of the model is the jib, which is carried on a sturdy superstructure built on a revolving base, the two main supports of the superstructure consisting of channel section girders braced to the base by means of further Angle Girders diagonally disposed. The jib itself is constructed in two separate sections, one of which is secured to the superstructure of the model and has the same cross-section for its entire length. It is built up from four 24½″ Angle Girders joined together by 5½″ Angle Girders, and the long square frame so formed is braced on two of its opposite sides with 5½″ and 2½″ Strips. This section of the jib is attached to the crane superstructure at one of its lower edges, and is held permanently in one position by means of links composed of short Strips.

The inner or sliding section of the jib is 24½″ long and at its inner end is 4½″ square. At the outer end it tapers almost to a point, the two sides being connected together by a 1″ Rod, on which a ½″ Loose Pulley rotates. The broad end is fitted with eight rollers that run on the inner edges of 24½″ Angle Girders forming the stationary part of the jib. These rollers consist of ¾″ Flanged Wheels, and are carried on 1½″ Rods mounted in the end holes of Double Brackets. The sliding part of the jib is raised and lowered by four hoisting cords operated by an ingenious lever mechanism situated at the top of the crane superstructure.

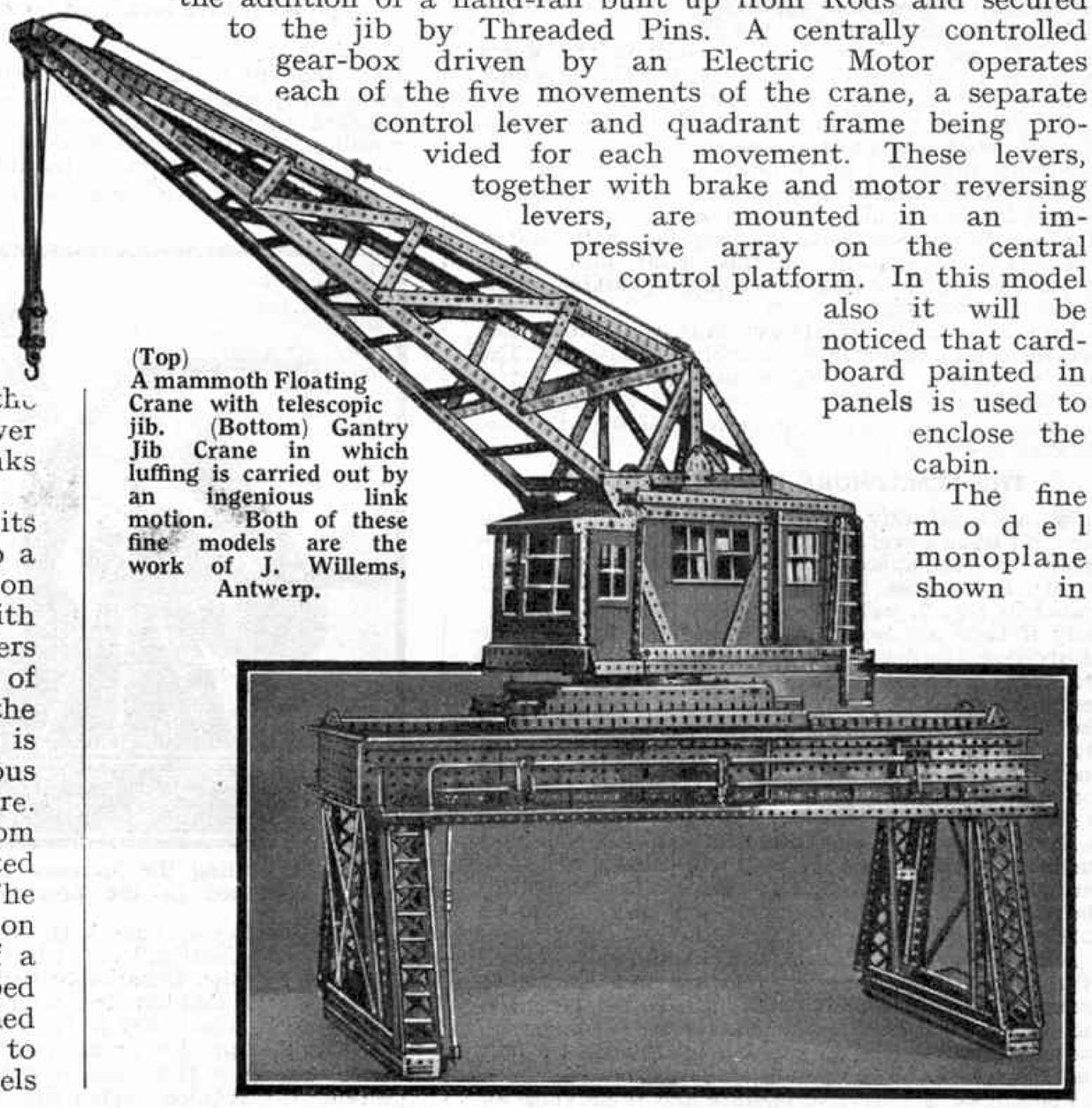
The underwater portion of the pontoon is constructed from Strips bolted to ribs formed by Curved Strips. These are bolted to the keel, which is built up from 18½″ Angle Girders. The deck is surrounded by a low rail of 12½″ Angle Girders, and on this rail 10 fairleads are provided, each of which consists of a Single Bent Strip fitted with two Rods. The pontoon is equipped with winches constructed from two Flanged Sector Plates joined together by two 1½″ × ½″ Double Angle Strips and then secured to the deck by four ½″ × ½″ Angle Brackets. Two 1⅛″ Flanged Wheels butted together form the hauling drums, which are rotated from a Crank Handle that operates through ratio 3 : 1 reduction gear.

The centre of the pontoon carries a short braced column that supports a Roller Bearing, to the upper section of which is bolted a platform built up from 5½″ × 18½″ Angle Girders, and which carries a square box-like frame. This is filled with pieces of lead and is fitted outside with three electric switches, two on one side and one on the opposite side. The movements of the crane are actuated by separate Motors, so that the construction of elaborate gear-boxes is made unnecessary and the control of the model is greatly simplified. The Motors are mounted on the 5½″ × 18½″ framework already mentioned, and are controlled by the switches on the platform. Each movement is driven by its respective Motor through a clutch operated by a foot-pedal in the control house. These clutches eliminate the use of variable resistances in the electric circuit.

The entire gear-box is housed in a cardboard framework mounted on a structure built up from Angle Girders of various lengths. The frame is 17″ in length and 3½″ in height, and at the sides the cardboard is cut away to represent windows. A touch of realism is given by lines drawn on the cardboard to represent matchboard panelling.

The gantry jib crane constructed by Willems is of special interest because of its remarkable neatness and the novel manner in which the Meccano parts are utilised. An example of this is found in the gantry, where 12½″ Braced Girders are used to give the legs the massive appearance they have in the actual crane. The gantry is 24½″ in length and travels on eight 1⅛″ Flanged Wheels, four of which are driven.

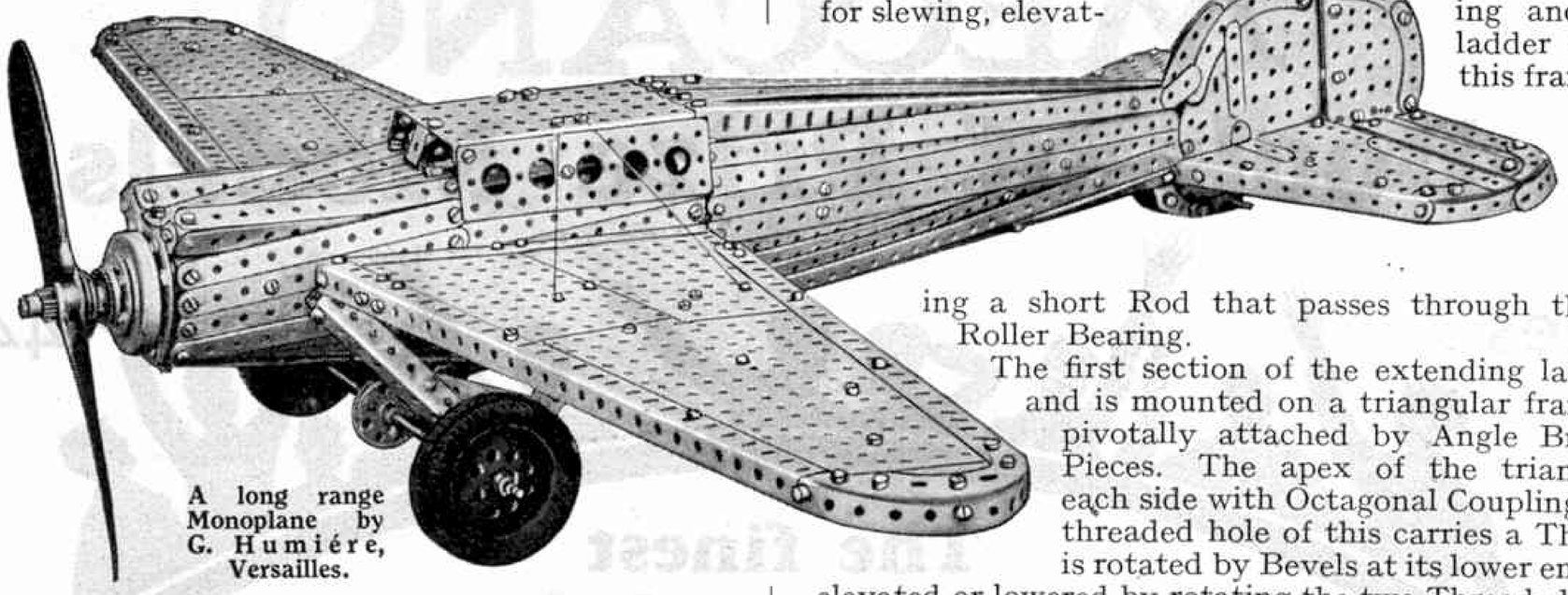
The slender jib is built up from 24½″ Angle Girders and is 5½″ square at the base, the head tapering off almost to a point. Luffing is carried out by an ingenious link motion operating on each side of the jib, the links being moved by Threaded Rods. The sides of the jib are braced by diagonal and vertical tension members, but the underside and top are fitted only with evenly spaced cross members. The appearance of the jib is improved by the addition of a hand-rail built up from Rods and secured to the jib by Threaded Pins. A centrally controlled gear-box driven by an Electric Motor operates each of the five movements of the crane, a separate control lever and quadrant frame being provided for each movement. These levers, together with brake and motor reversing levers, are mounted in an impressive array on the central control platform. In this model also it will be noticed that cardboard painted in panels is used to enclose the cabin.



(Top) A mammoth Floating Crane with telescopic jib. (Bottom) Gantry Jib Crane in which luffing is carried out by an ingenious link motion. Both of these fine models are the work of J. Willems, Antwerp.

The fine model monoplane shown in

the upper illustration on this page represents a type of machine used for long-distance passenger flights. It was built by G. Humiére, Versailles. The rear of the fuselage of the model is cleverly moulded by carefully bent Strips, and similar parts are used for the front. The cylinder cowlings for the engine are represented by $5\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strips and $5\frac{1}{2}''$ Strips. The cabin roof consists of a $5\frac{1}{2}'' \times 2\frac{1}{2}''$ Flanged Plate, and each side of the cabin is built up from two $3'' \times 1\frac{1}{2}''$ Flat Plates that overlap each other two holes, and in which $\frac{1}{2}''$ holes are drilled to represent windows. I do not like to see Meccano parts mutilated to this extent, and I think it would be better to use 1" Loose Pulleys bolted to the Plates. The complete cabin is secured in place by means of two Double Brackets, and at the rear is moulded into the fuselage by a long sloping projection constructed from two $12\frac{1}{2}''$ Angle Girders. The space between these two Girders is filled in by means of three $12\frac{1}{2}''$ Strips, the ends of which are brought together and bolted at one point at the rear of the model.



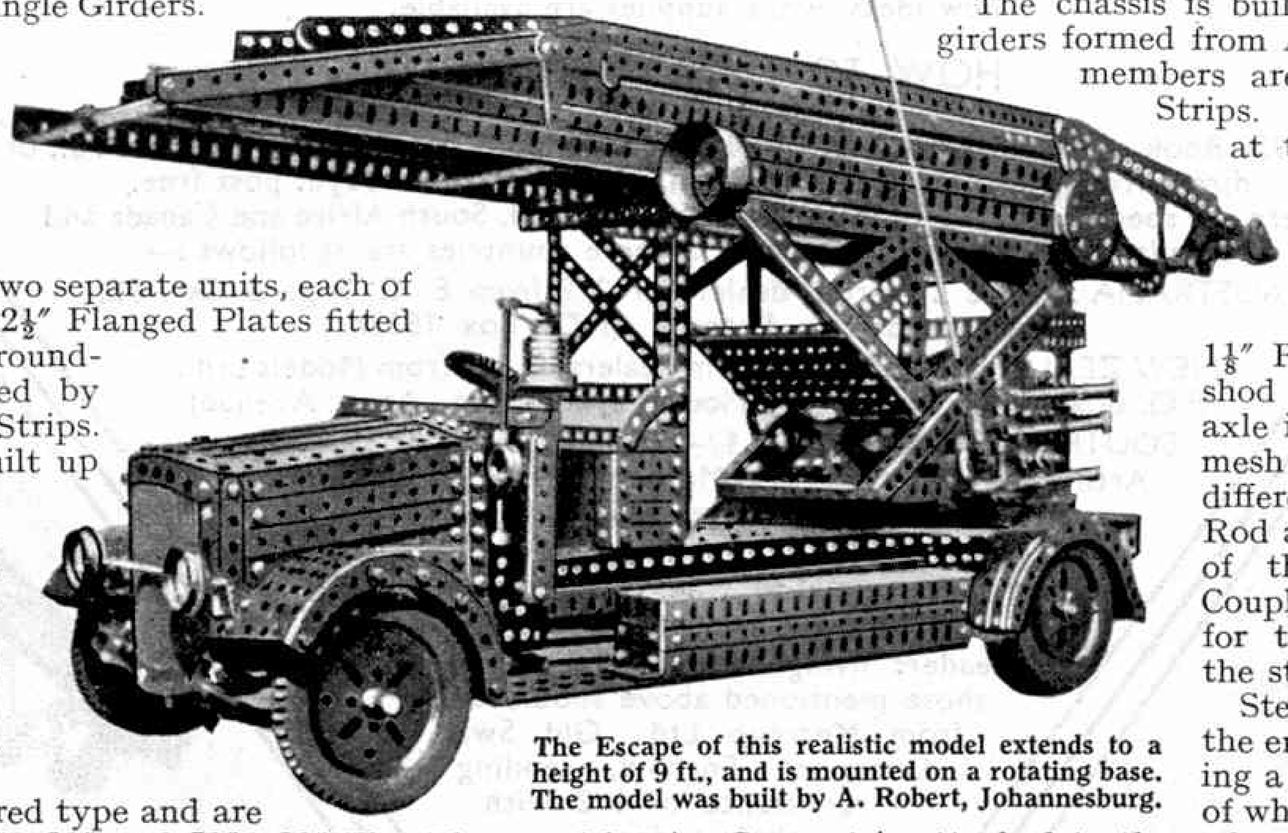
A long range Monoplane by G. Humiére, Versailles.

The rudder is built up in two separate units, each of which consists of two $3\frac{1}{2}'' \times 2\frac{1}{2}''$ Flanged Plates fitted with two Face Plates. The rounded outside edge is obtained by using Large Radius Curved Strips. The tail planes are each built up from a Sector Plate and a Flat Plate, and the elevators, made from Flat Girders, are held in place by means of Hinges. The control wires pass inside the fuselage to the cockpit, where they are attached to their respective levers.

The wings are of the tapered type and are neatly constructed from $5\frac{1}{2}'' \times 3\frac{1}{2}''$ and $5\frac{1}{2}'' \times 2\frac{1}{2}''$ Flat Plates, with an edging consisting of two Angle Girders and a curved Strip. The Strip is bent round the outside of a $2\frac{1}{2}''$ Small Radius Curved Strip, and is bolted to the ends of the two Angle Girders.

The remaining models illustrated this month are representative types of motor vehicles, of which several hundreds were entered in the Contest. The models shown are not necessarily the best that were submitted, but have been chosen because they each represent a distinct type, and so will be of interest to the majority of readers. The first to be dealt with is a fine motor fire escape, by A. Roberts, Johannesburg. The chassis of the model is similar to the Meccano Super Model Motor Chassis, except that Roberts' model is a little longer. An Electric Motor is housed beneath the bonnet and the drive is transmitted through a single plate clutch to a three-speed and reverse gear-box. A short cardan shaft connects the gear-box with the differential gear.

The extending escape is the main feature of the model. It is mounted on a turntable framework immediately over the rear axle, and the base of the frame consists of a Circular Plate that rotates on the loose pulleys of a roller bearing. The controls for slewing, elevating and extending the ladder are mounted on this frame, and the drive for the three movements is taken from the Motor by means of Bevel Gears operating a short Rod that passes through the centre of the Roller Bearing.



The Escape of this realistic model extends to a height of 9 ft., and is mounted on a rotating base. The model was built by A. Robert, Johannesburg.

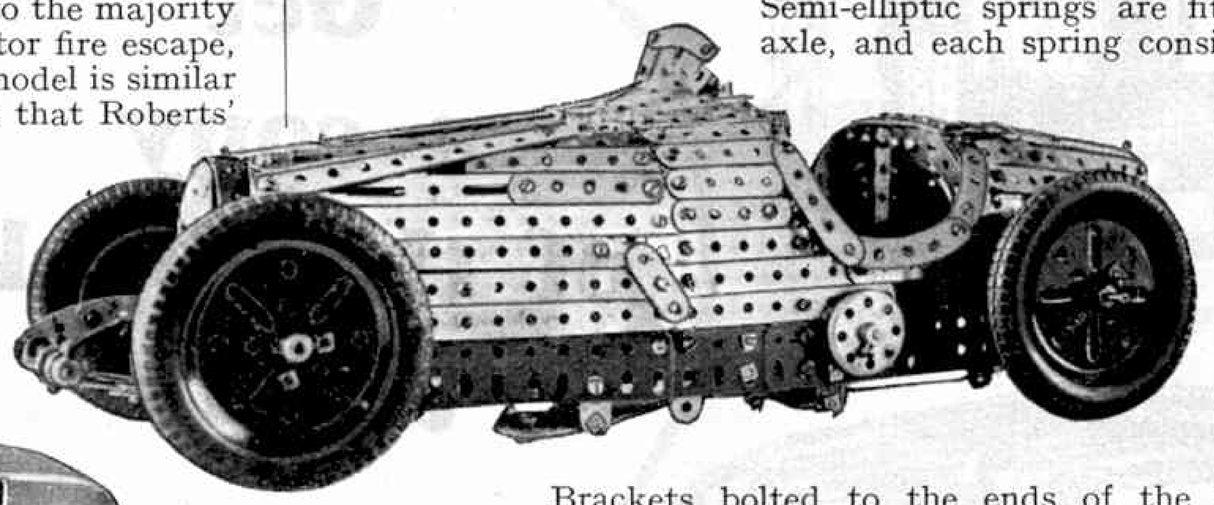
The first section of the extending ladder is 40" long, and is mounted on a triangular frame to which it is pivotally attached by Angle Brackets and Eye Pieces. The apex of the triangle is fitted on each side with Octagonal Couplings, and the centre threaded hole of this carries a Threaded Rod that is rotated by Bevels at its lower end. The ladder is elevated or lowered by rotating the two Threaded Rods. The first section of the ladder also carries the hoisting drum for extending the three telescopic sections.

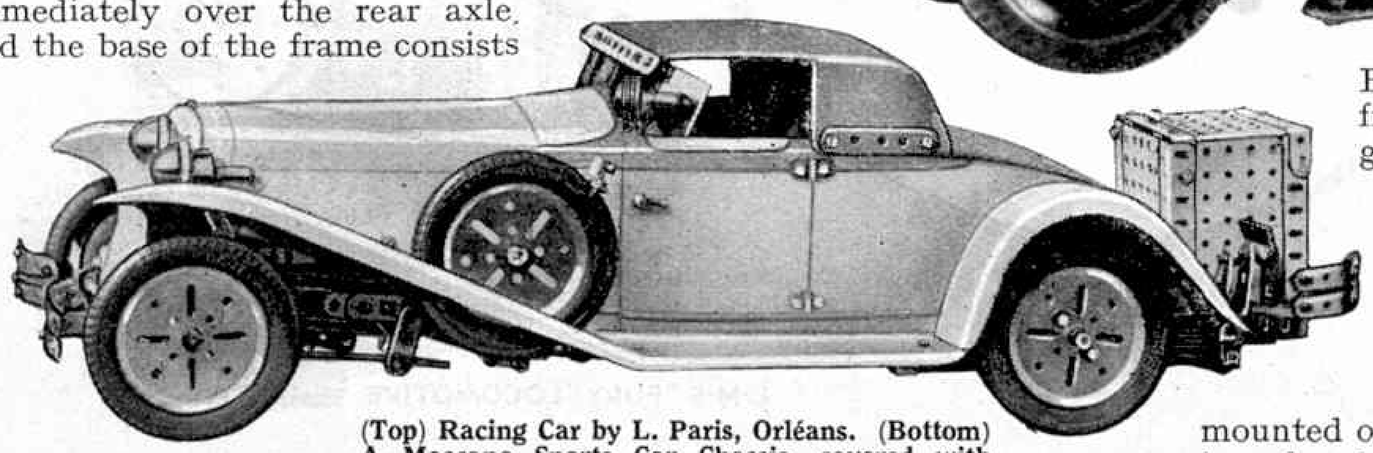
Very pleasing results can be obtained by covering the bodywork of a model car with sheet metal, and a good example of this is shown in the front-wheel drive two-seater sports car constructed by J. Magnussen, Oslo. The constructional details of the model have been carried out with the same care and skill as the bodywork.

The chassis is built up of strong channel section girders formed from Angle Girders, and the two side members are rigidly braced by means of Strips. An Electric Motor is mounted at the front of the chassis and a three-speed gear-box is fitted immediately beneath it. The drive from the Motor is taken through Bevel Gearing to a friction clutch consisting of a $1\frac{1}{8}''$ Flanged Wheel and a 1" rubber shod Pulley. The final drive to the axle is passed through a $\frac{1}{2}''$ Bevel in mesh with a $1\frac{1}{2}''$ Bevel Wheel in the differential. The $\frac{1}{2}''$ Bevel is on a short Rod attached to the final driven Rod of the gear-box by a Universal Coupling, and similar Couplings allow for the flexibility of the drive to the stub axles.

Steering is effected by a Pinion on the end of the steering column engaging a $1\frac{1}{2}''$ Contrate Wheel, on the Rod of which a Crank is fixed. A Handrail Support is attached to the web of the Crank and carries an Axle Rod connected to the stub axle. Internal expanding brakes are fitted to the rear wheels, the brake drums being formed by bolting Boiler Ends to 3" Pulley Wheels representing the road wheels.

L. Paris of Orléans, was another competitor who chose a motor car as his subject. This time it is a typical speed car of the "baby" class. The chassis is composed of Flat Girders and Angle Girders, and is extended at the front by $2\frac{1}{2}''$ Large Radius Curved Strips. Semi-elliptic springs are fitted to each axle, and each spring consists of Strips of various lengths, bent slightly and pivotally connected to the chassis by Flat Brackets lock-nutted to Double Brackets bolted to the ends of the spring. The front wheels are controlled by Ackermann steering gear operated through Bevel Gearing.





(Top) Racing Car by L. Paris, Orléans. (Bottom) A Meccano Sports Car Chassis, covered with metal bodywork, which won a prize for J. Magnussen Oslo.

The power is supplied by a 6-volt Electric Motor and a novel feature of the gear-box is that it is mounted transversely in the chassis and drives the back axle through Bevel Gears.

Internal expanding brakes are fitted on all four wheels, and in each case the brake drums are formed by Wheel Flanges and the slippers are mounted on a Face Plate. The rear wheel brakes are operated by a hand lever and those on the front wheels by a foot-pedal.

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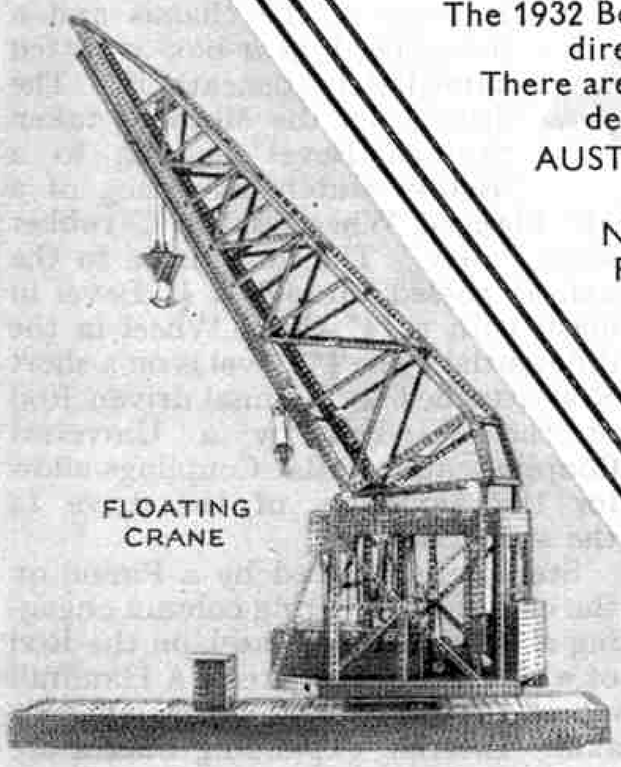
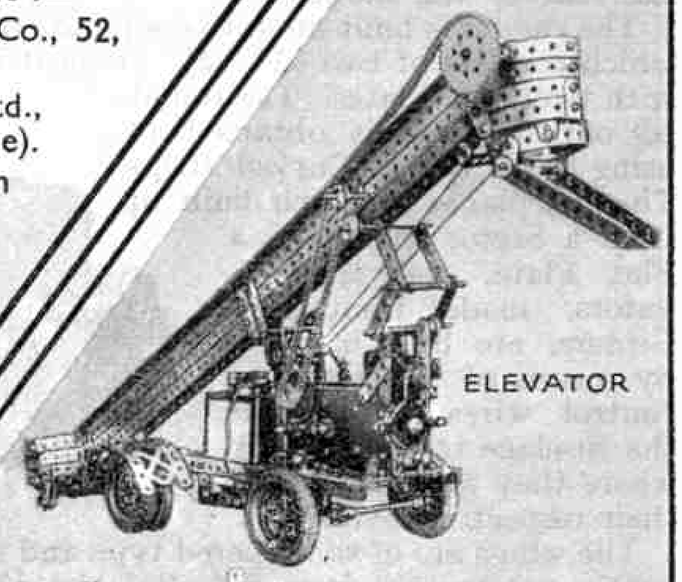


FLOATING CRANE



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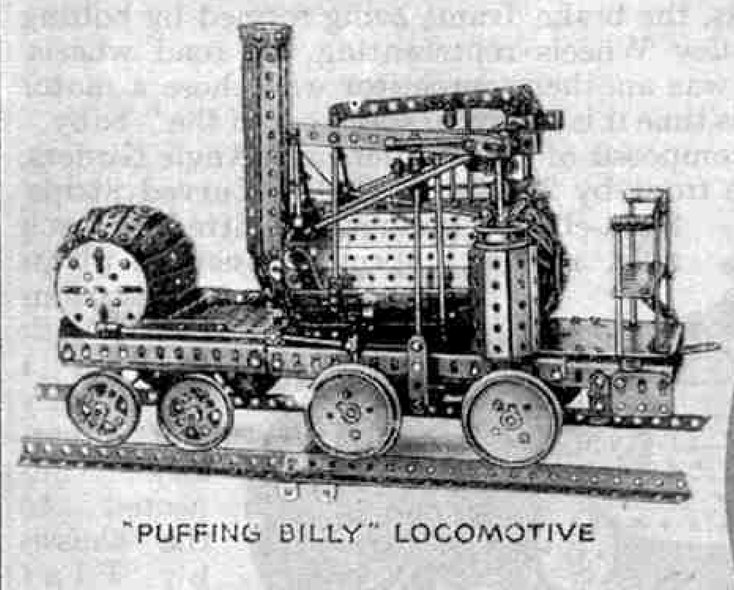
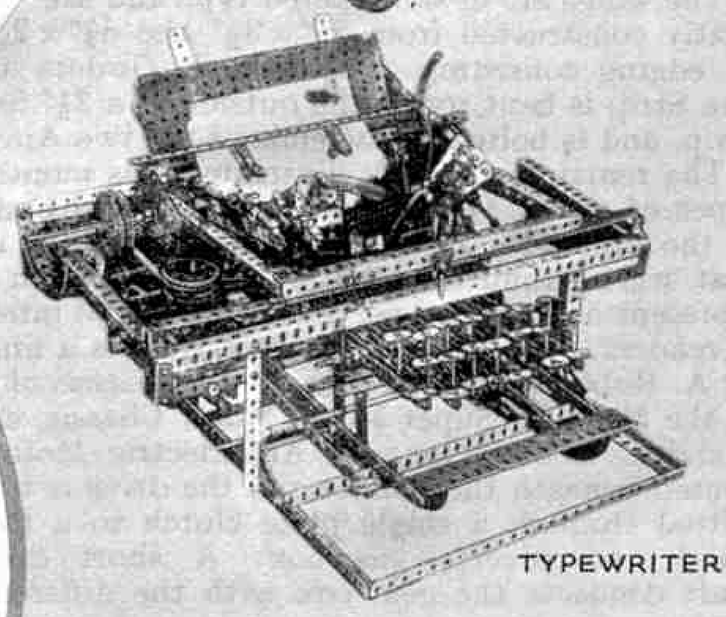


"PUFFING BILLY" LOCOMOTIVE



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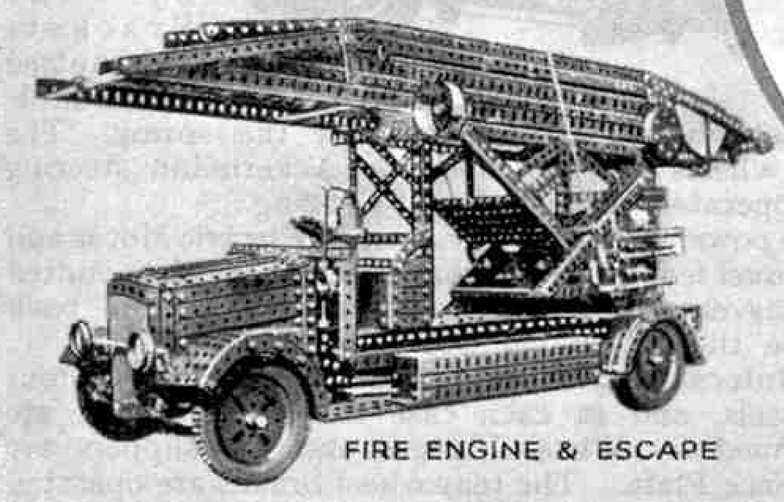
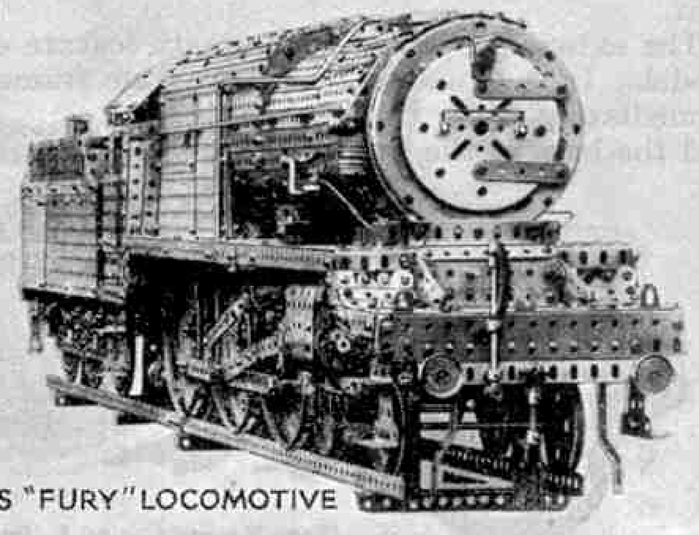


FIRE ENGINE & ESCAPE



L·M·S "FURY" LOCOMOTIVE

Model-Building Contest Results

By Frank Hornby

"Simplicity" Contest (Home Sections)

This month I am able to publish the names of prize-winners in the Home Sections of the "Simplicity" Model-building Competition, details of which were announced in the May, 1932, issue of the *"M.M."* The awards are as follows:—

Section A (competitors over 14)

First Prize, Meccano goods value £3-3s.: A. Malloch, Brighton. Second Prize, Meccano goods value £2-2s.: L. H. C. Willis, London, W.2. Third Prize, Meccano goods value £1-1s.: Donald McLean, Moss Side, Manchester.

Five Prizes of Meccano goods value 10/6: C. Reed, Gourock, Renfrewshire; W. Temple, Greenock; W. Munder, New Malden, Surrey; J. Wilson, Aberdeen; J. Boswell, Ayr.

Prizes of Meccano Engineer's Pocket Books and Certificates of Merit: R. Rankin, Banbury, Oxon; J. Cunliffe, Burton-on-Trent; J. Trevethan, Bere Ferrers, S. Devon; S. Farr, Gravesend; Miss A. Potton, Braintree, Essex; E. Robinson, London, N. 10; G. Bunker, Grimsby; M. Powley, Sunderland; R. Storrar, Letham Ladybank, Fifeshire; W. Clement, Willington, Co. Durham; E. Reed, Gourock, Renfrewshire; R. Bentley, Blackpool; F. Thornton, Scarborough; N. Reed, Letchworth; F. Croydon, Newton Abbot; H. Tomlinson, Blackpool; I. Morton, Edinburgh; R. Alderson, Cleckheaton, Yorks.; G. Hawkins, Erdington, Birmingham; S. Smith, London, S.E.4; R. Evans, London, N.16; H. Palmer, Portsmouth; R. Sargeant, Boston, Lincs.

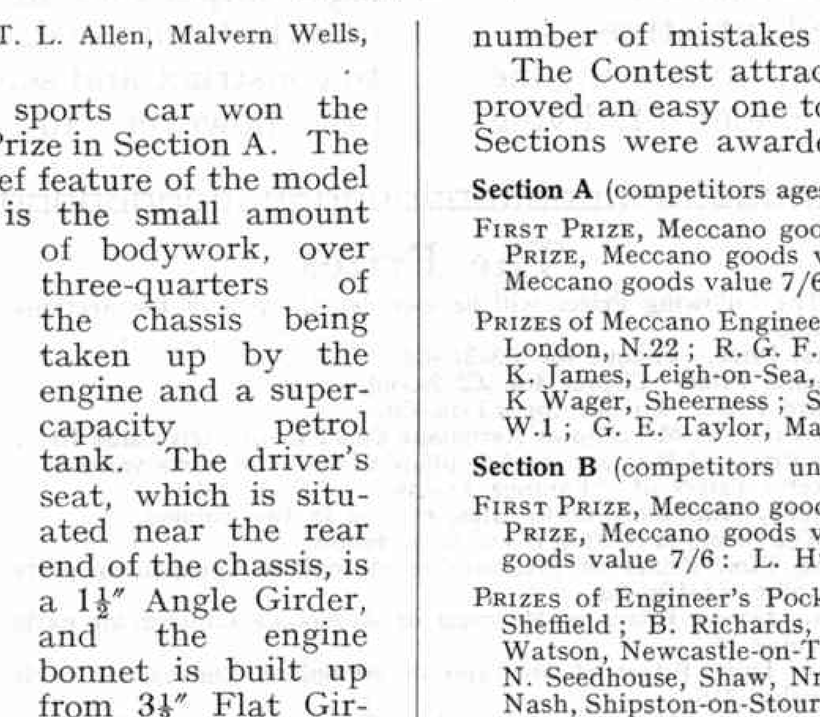
Certificates of Merit: H. James, Harlington, Middx.; V. Robinson, Fleetwood; B. Nicol, Aberdeen; R. Bratherton, London, S.W.15; W. Bond, Beckenham, Kent; F. Moon, Grays, Essex; F. Robey, Melbourne, Derby; R. York, Sheffield; E. Reader, Stone, Staffs.; R. Nicholas, Portsmouth; R. Norris, Ebbw Vale, Mon.; L. W. Harris, Coventry; H. Hill, Sheffield.

Section B (competitors under 14)

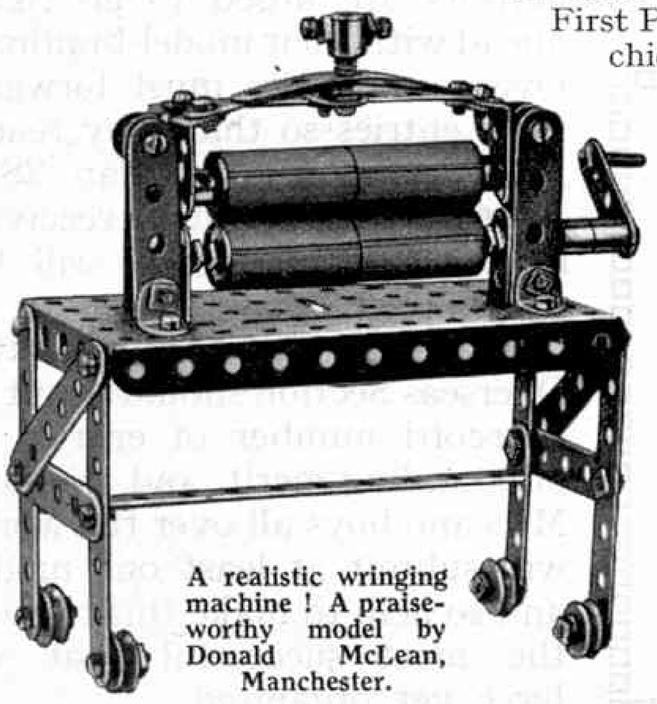
Two First Prizes of Meccano goods value 21/-: D. Huggan, Headingley, Leeds; A. W. Shaw, Stalybridge. Two Second Prizes of Meccano goods value 15/-: W. P. Dallas Ross, Englefield Green, Surrey; J. Macken, Bromley, Kent. Two Third Prizes of Meccano goods value 10/6: E. G. B. Mitchell, Sutton, Surrey; M. Whittet, Glasgow, W.3.

Five Prizes of "How to Use Meccano Parts" Manuals: Harold Sisley, Surbiton; Leslie Bridgeman, Woodford Green, Essex; H. W. Pont, East Ham, E.6; J. H. Thorp, Grantham; F. E. Dorwick, Corbridge-on-Tyne, Northumberland.

Prizes of Certificates of Merit and Engineer's Pocket Books: Aubrey Rombulow-Pearse, Southsea; G. J. Shaw, Portsmouth; C. T. Holland, London, S.E.18; R. Venning, Bridgend; Miss V. Wood, London, W.11; F. L. Sawyer, Burwash, Sussex; J. Shuttleworth, South Harrow; B. Burns, East Finchley, N.2; R. Oakley, Blackburn; J. Wilson, London, N.W.6; J. T. Cowie, Pitcaple, Aberdeenshire; A. Henshaw, Kimberley, Notts.; J. Mappleback, Huddersfield; S. Smith, London, S.W.19; Miss M. Kaile, Mayford, Nr. Woking; J. A. Drane, Sudbury, Suffolk; B. J. Stedman, Coulsdon; Surrey; R. McCall, Cork; B. Venning, Bridgend; K. A. Marshall, Weymouth; A. H. Greenhalgh, Leicester; A. O. Viney, Eccles; R. T. L. Allen, Malvern Wells, Worcs.; R. Banks, South Harrow.



A scene in a dentist's surgery; note the tooth (a Bolt) in the forceps! This "simplicity" model was submitted by J. Macken, Bromley.

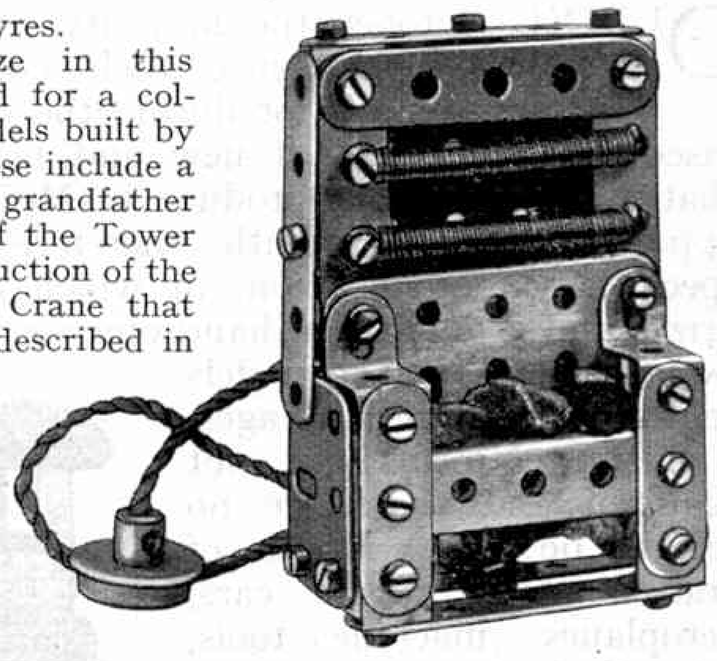


A realistic wringing machine! A praiseworthy model by Donald McLean, Manchester.

A neat sports car won the First Prize in Section A. The chief feature of the model is the small amount of bodywork, over three-quarters of the chassis being taken up by the engine and a supercapacity petrol tank. The driver's seat, which is situated near the rear end of the chassis, is a 1½" Angle Girder, and the engine bonnet is built up from 3½" Flat Girders. The wheels are 1" Pulleys provided with Meccano miniature Dunlop Tyres.

The Second Prize in this Section was awarded for a collection of simple models built by L. H. C. Willis. These include a trench excavator, grandfather clock, a miniature of the Tower Bridge, and a reproduction of the "Demag" Floating Crane that was illustrated and described in the *"M.M."* for September, 1928.

The Tower Bridge is a very realistic model, each of the two end towers being made from 3½" Flat Girders crowned with a 1" Triangular Plate for the apex. The high-level roadway is formed from two 4½" Angle Girders and the bascules are 1½" Flat Girders.



A. W. Shaw, Stalybridge, finds a novel use for Meccano Springs as the resistance elements in this realistic electric fire.

A wringing machine in which the rollers are formed from Sleeve Pieces pushed over Chimney Adaptors, was submitted by D. McLean.

A. W. Shaw's electrical fire is of very simple construction yet the realism is remarkable, much of the fine effect being due to the use of Springs to represent the resistance elements.

April "Errors" Competition

In the April, 1932, issue of the *"M.M."* we published an illustration of a Meccano ship in building which a great many mistakes had been made, both in its design and construction. This model was the subject of an "Errors" Competition, and competitors were asked to write down on a sheet of paper as many of the errors in the model as they could find. Prizes were offered to those competitors who submitted the lists containing the greatest number of mistakes actually present in the model.

The Contest attracted a good deal of attention, and the task proved an easy one to most competitors. The prizes in the Home Sections were awarded as follows:—

Section A (competitors ages 12 to 16)

First Prize, Meccano goods value £1-1s. C. Eagling, London, S.W.14. Second Prize, Meccano goods value 15/-: F. Thornton, Scarborough. Third Prize, Meccano goods value 7/6: R. I. Sargeant, Sibsey, Nr. Boston.

Prizes of Meccano Engineer's Pocket Books:—W. Raybould, Walsall; H. W. Webb, London, N.22; R. G. F. Paton, Kilmarnock; A. F. Izeth, Sutton Valence, Kent; K. James, Leigh-on-Sea, Essex; C. A. Hopkins, Warrington; H. Cowling, Ossett; K Wager, Sheerness; S. Horne, Brightside, Nr. Sheffield; E. Everill, London, W.1; G. E. Taylor, Margate; K. J. Spatchet, London, N.W.10.

Section B (competitors under 12)

First Prize, Meccano goods value £1-1s.: M. H. Bull, Morley, Nr. Derby. Second Prize, Meccano goods value 15/-: H. Bailey, Derby. Third Prize, Meccano goods value 7/6: L. Humfryes, Worthing.

Prizes of Engineer's Pocket Books:—J. George, Bordon, Hants.; G. D. Fallas, Sheffield; B. Richards, Sittingbourne, Kent; G. D. Askew, London, W.11; F. Watson, Newcastle-on-Tyne; D. Svetchford, London, E.11; K. Corner, Derby; N. Seedhouse, Shaw, Nr. Oldham; A. W. Elliott, Woodford Green, Essex; A. Nash, Shipston-on-Stour, Warks; A. Greaves, Skegness; N. G. Findlay, Kippen, Stirlingshire; C. Scrase, Horsham, Sussex; C. Whitmarsh, Burton-on-Trent.

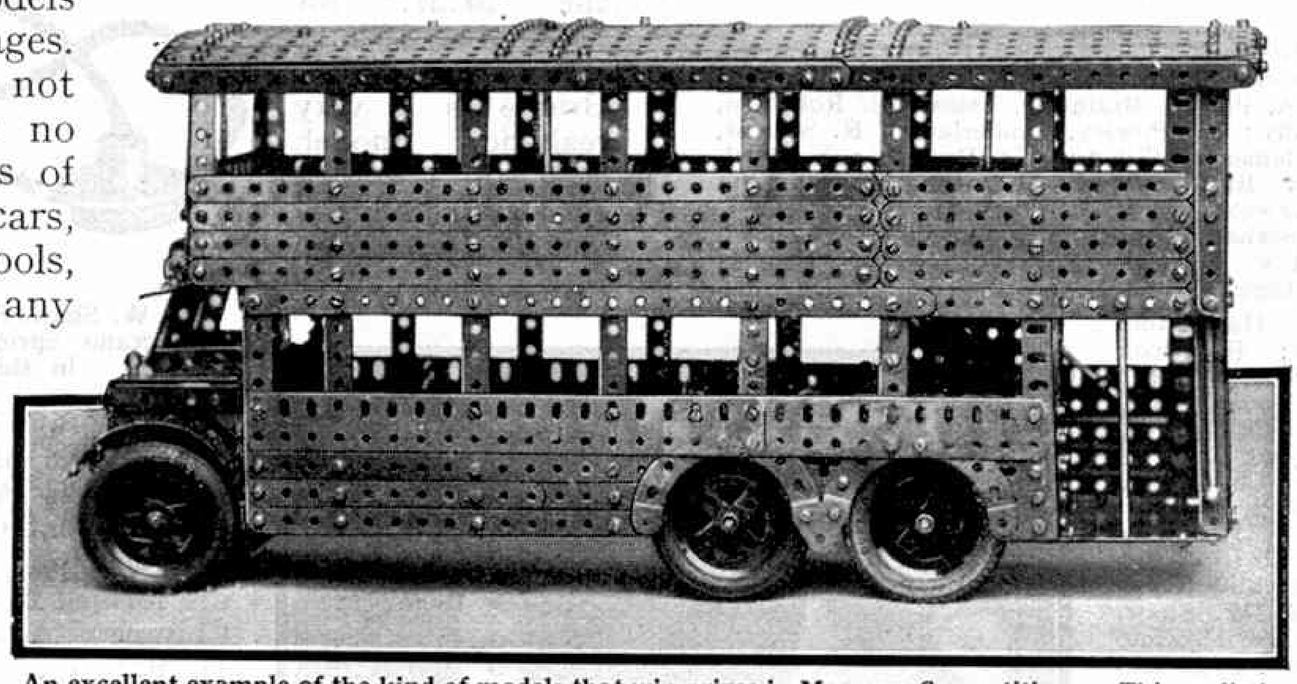
The results in the Overseas Section of the Competition will be announced as soon as possible.

"Autumn" Model-Building Competition

How to Win a Big Prize!

DURING October the majority of Meccano model-builders recommence their constructional work in real earnest, for during the summer they have discovered all kinds of new and fascinating subjects that they want to reproduce in Meccano at the first opportunity. This month, therefore, we announce a special open competition, in which over 70 valuable prizes and a number of handsome Certificates are to be awarded for the best models sent in by readers of all ages.

Entrance forms are not required and there are no fees to be paid. Models of cranes, ships, motor cars, aeroplanes, machine tools, scientific instruments, or any other subject may be submitted, and the competitor is not limited to any particular size of Outfit or number of parts. Models may be constructed with just those parts that are found necessary.



An excellent example of the kind of models that win prizes in Meccano Competitions. This realistic Motor Omnibus was built by A. Leonard, Blackheath, and was awarded a prize in the £500 Model-Building Competition, 1932.

Actual models must not be sent. It is only necessary to submit either clear photographs or, if this is not possible, good drawings of models, together with a brief but concise explanation of any constructional or mechanical features that are not easily apparent from the illustrations. Neither photographs nor drawings need be the competitor's own handiwork, but it is absolutely essential that the model itself is his own unaided work.

The whole field of engineering, architecture and science is available for competitors to choose their subjects from, and there are hundreds of interesting machines and mechanical devices that have not yet been built by competitors in Meccano Contests.

Entries in this contest will be divided into three sections—Section A, for readers over 14, living in the British Isles; Section B, for readers under 14, living in the British Isles; and Section C, for readers of all ages living Overseas.

The competitor's name, address, and age must be written clearly on the back of each photograph or drawing sent in, together with the section (A, B or C) for which the entry is eligible. Envelopes containing entries should be addressed "Autumn" Model-Building Competition, Meccano Ltd., Binns Road, Old Swan, Liverpool. All photographs of prize-winning models become the property of Meccano Ltd., but unsuccessful entries will be returned to the senders after the close of the Contest, *provided that a stamped addressed envelope is enclosed with the entry.*

Competitors may, if they wish, submit more than one model, but in this event all entries must be sent under the same cover. No single competitor will be awarded more than one prize, and if more than one model is submitted they will be considered jointly.

We wish to remind competitors of the advantage of submitting photographs in preference to drawings, whenever it is possible to do so. Drawings will do quite well provided that they show all the important details clearly, but so few boys are able to draw mechanical subjects distinctly and in correct perspective that generally a photograph is the only illustration from which the merits of a model can be properly and fairly judged. The photographs need not be large, however; the main point is to see that the model is clearly defined, sharp in focus, and that the background is such that it will not tend to obliterate the details of the model. A plain sheet of brown paper makes an admirable background. A good photograph can be obtained with even a small box-form camera, provided that it is not placed too close to the model and that sufficient exposure is given.

November 30th, 1932, is the last day on which entries will be received in the Home Sections (A and B). Intending competitors in either of these Sections have two months from the date of publication of this issue in which to construct and send in their entries. No time must be lost, however, and competitors are urged to go right ahead with their model-building. Overseas readers must forward their entries so that they reach Liverpool not later than 28th February, 1933. Entries received after the above dates will be disqualified.

The ample time allowed in the Overseas Section should result in a record number of entries of outstanding merit, and we hope Meccano boys all over the world will submit at least one model and so help to make this contest the most successful that we have yet organised.

The Prizes

The following Prizes will be awarded in each of the Sections A and C.

First Prize. Cheque for £3-3s.-0d.
Second Prize. Cheque for £2-2s.-0d.
Third Prize. Cheque for £1-1s.-0d.
Six Prizes of Meccano or Aeroplane Constructor parts value 10/-.
Six Prizes of Meccano or Aeroplane Constructor parts value 5/-.
Twelve Prizes of "Famous Trains" by C. J. Allen.
Twenty Handsome Certificates, printed in two colours.

The Prizes in Section B will be as follows:—

Two First Prizes of Meccano or Aeroplane Constructor parts value £1-10s.-0d.
Two Second Prizes of Meccano or Aeroplane Constructor parts value 15/-.
Two Third Prizes of Meccano or Aeroplane Constructor parts value 7/6.
Six Prizes of Meccano or Aeroplane Constructor parts value 5/-.
Twelve Meccano Engineer's Pocket Books.
Twenty Handsome Certificates, printed in two colours.

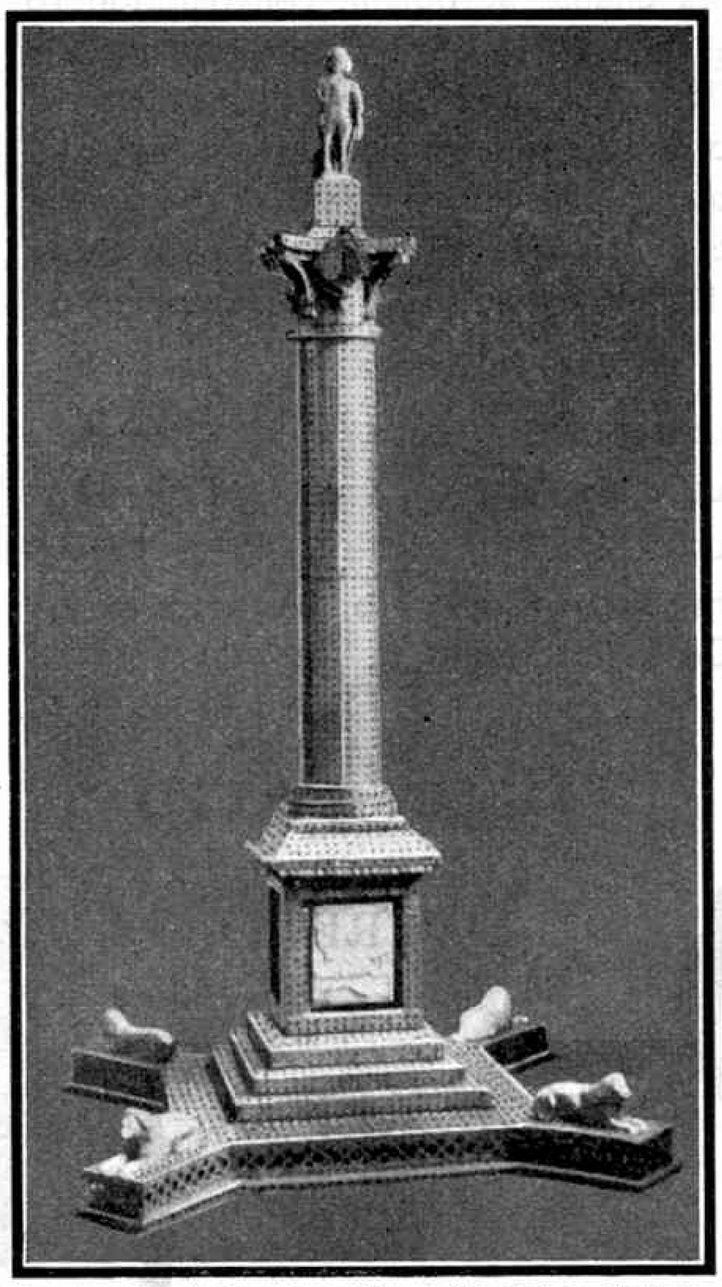
The "Nelson Column" in Meccano

A Novel and Interesting Subject for Model-Builders

ONE of the greatest joys that Meccano model-building offers to the constructor is that obtained when, after many pleasant hours spent in building a model, he is able to set it working and see it operate exactly in the same manner as its prototype. It is natural, therefore, that the majority of Meccano model-builders should devote their attention almost entirely to the construction of working models. There are many other interesting forms of model-building, however, such as the construction of miniature representations of architectural subjects. The suitability of Meccano for work of this kind is well shown by the model of the Nelson Column, London, illustrated on this page.

This fine model is the work of a keen enthusiast, Mr. L. W. Grey, of Cowes, I.O.W., and the following details concerning it will no doubt be welcome to many Meccano engineers who would like to try their hands at this novel form of model-building.

The Nelson Column, which is one of the most familiar of all London's historic landmarks, was erected by public subscription to commemorate Lord Nelson's victory at the battle of Trafalgar. The Column rises up in the centre of Trafalgar Square. Its total height, including the statue of Nelson that it supports, is 145 ft. It is built mainly of granite, and it stands on a massive stone bed, at each corner of which is a huge stone lion. These lions were modelled by the famous British artist Sir Edwin Landseer in 1868. The style of the Column is Corinthian, and it carries a capital modelled in gunmetal. The pedestal on which the column proper rests is enriched with bronze reliefs. Particular interest is attached to these ornamentations, for they were cast from the metal of a number of guns that had been captured from the French.



A cleverly designed model of the Nelson Column, London, built by Mr. L. W. Grey, and described in this article.

The construction of the model is best dealt with by commencing at the foot and working towards the top. Each side of the base measures $19\frac{1}{2}''$ in length and is built from Angle Girders, the top of the frame being filled in with Flat Plates of various sizes. Braced Girders are secured to the sides, and the whole is finished by a beading formed from Angle Girders.

Built on, and immediately above the base, are three steps, each rising 1", and composed of Angle and Flat Girders. The base of the plinth is set above the steps, and measures $7\frac{1}{2}'' \times 7\frac{1}{2}''$. It has a panel $6\frac{1}{2}'' \times 5\frac{1}{2}''$ sunk into each face, and is built up from a number of $5\frac{1}{2}'' \times 3\frac{1}{2}''$ Flat Plates, Flat Girders and Angle Girders. Above the first plinth rises a second, which is formed from $7\frac{1}{2}''$ Flat Girders and Corner Brackets; and this is topped by a platform that measures $6\frac{1}{2}'' \times 6\frac{1}{2}''$, to the centre of which is fixed a Face Plate.

The column itself is built from eight $24\frac{1}{2}''$ and eight $4\frac{1}{2}''$ Angle Girders, which are secured at both ends to Double Brackets. These Double Brackets are bolted octagonally to the insides of the Hub Discs shown in the illustration, and the intermediate spaces are filled in with $12\frac{1}{2}''$ Strips, supplemented by a number of $4\frac{1}{2}''$ Strips. At the upper end of the column is a ring formed by a Circular Girder, through which pass the Strips and Angle Girders forming the column. Round the Circular Girder are placed $2\frac{1}{2}''$ large radius Curved Strips, and at the base of the column a Circular Plate is fastened.

Under the capital are four $5\frac{1}{2}''$ Curved Strips, to which are fastened $1\frac{1}{2}''$ Perforated Strips, in sets of three, to form an ornament. The top of the column is fitted with a ring of "cabling," formed from Spring Cord screwed or bound round pieces of ordinary Meccano Cord. Above the cabling is a ring or band composed of a Hub Disc, inside of which are Double Brackets. To this Disc the Angle Girders and Strips comprising the column are fastened. The completed column is secured to the plinth by means of short lengths of screwed Rods and Nuts.

The top edge of the plinth is ornamented with mouldings, formed from Handrail Supports, Collars and Couplings fastened to Axle Rods. The realistic construction of this moulding is a task that taxes the model-builder's sculptural capabilities to the utmost. The statue and the lions are modelled out of putty, but if desired they may be bought ready-made from Hobbies Ltd., Dereham, Norfolk.

The total height of the model is $60\frac{1}{2}''$.

Model-building of this kind offers wonderful scope for ingenious constructors, and there are endless interesting subjects waiting to be reproduced. After reading this article there is no doubt that many boys who have not yet tested their skill in this class of work will wish to do so at the earliest opportunity. In order to encourage such boys in their efforts we intend to organise a special model-building contest in which only models of monuments and subjects of a similar nature will be eligible.

Full details of the new competition will be announced in next month's "*M.M.*," and we advise intending competitors to set to work on their models immediately, so that they will have plenty of time to rebuild and revise them if necessary. Suitable subjects for models are to be found in almost every town and village.

MECCANO

AEROPLANE CONSTRUCTOR OUTFITS

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The new Meccano Aeroplane Constructor Outfits afford every boy the thrill of building his own aeroplanes, plus the joy of possession. The parts contained in these Outfits enable aeroplane construction to be carried out on sound engineering lines. They are all interchangeable on the famous Meccano principle. The illustrated Manual of Instructions included in the Outfit shows how to build wonderful models of high and low-wing Monoplanes, Biplanes, Seaplanes and giant amphibian machines; in fact, models of almost every type of aircraft can be made with these splendid Outfits. If you want to know something about aeronautics, buy an Outfit to-day.

Meccano Aeroplane Constructor Outfit No. 0 ... ... Price **5**/–
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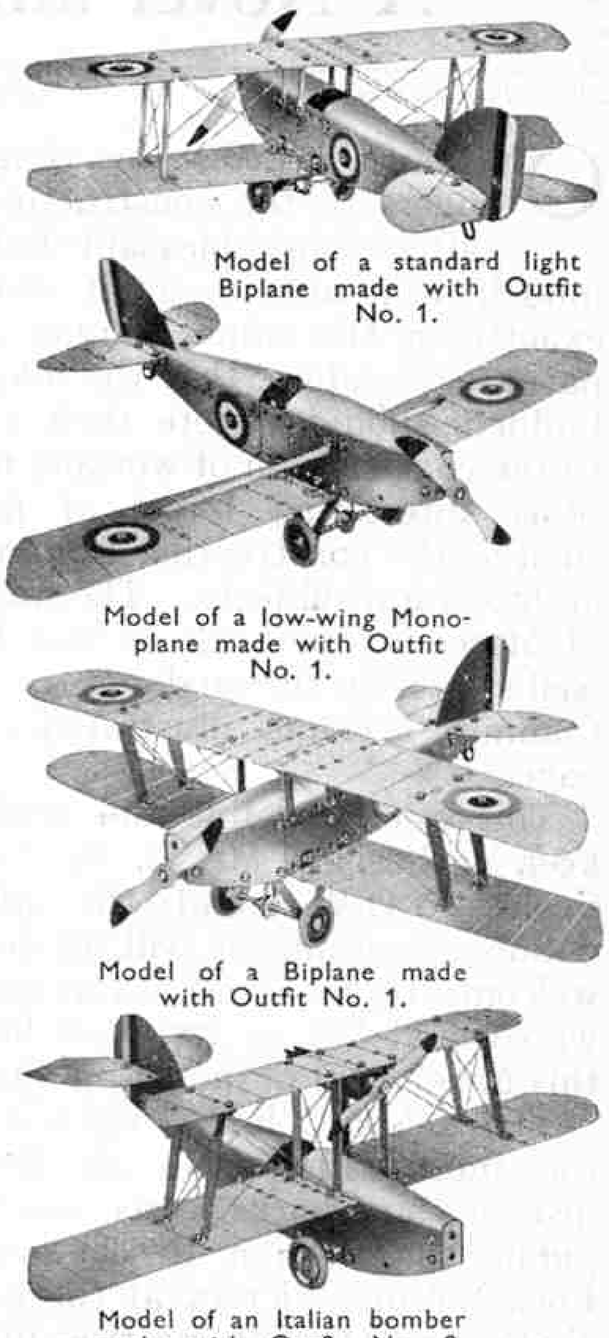
Meccano Aeroplane Constructor Outfit No. 2 ... ... Price **16/6**
A Meccano Accessory Aeroplane Constructor Outfit No. 1A (price **8/6**) converts a No. 1 Outfit into a No. 2.



Model of a standard light Biplane made with Outfit No. 1.

Model of a low-wing Monoplane made with Outfit No. 1.

Model of a Biplane made with Outfit No. 1.

Model of an Italian bomber made with Outfit No. 2.

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The Meccano Graphing Screen

A Useful Device for the Amateur Draughtsman

NATURAL ability for drawing is a great asset to the Meccano engineer, as it enables him to make on the spot sketches of any engineering structures that strike his fancy, and thus secure records to which he can refer at any time when he wishes to reproduce these structures in Meccano. In actual engineering, of course, good draughtsmanship is absolutely essential to the success of any scheme, small or large. Every detail of a bridge, crane, or machine of any kind must be drawn exactly to scale before any constructional work can be commenced.

In order to encourage model-builders to develop their models on actual engineering lines, we introduced some time ago an "*Engineer's Pocket Book.*" A feature of special interest in connection with this book is that graph paper is used throughout, the rulings providing $\frac{1}{8}$" squares. The squared paper is of great assistance in proportioning accurately the various sections of a drawing, and it will be found particularly helpful to boys who have no special aptitude for sketching. This month we give details of a novel instrument that greatly facilitates the task of preparing a reduced reproduction of a large illustration or line drawing. The majority of model-builders will have wished on many occasions to prepare a small sketch of a large newspaper or magazine illustration of some engineering structure or machine, and the instrument to be described is specially adapted for work of this kind.

The device, which is known as a graphing screen, has been designed by Mr. J. Healey, of Melksham, Wilts., and although very simple in construction it performs its function admirably. The screen consists essentially of a rectangular metal frame composed of Meccano Strips. Between the Strips forming the sides of the frame are stretched lengths of coloured thread, so that the area enclosed by the Meccano Strips is divided into a number of $\frac{1}{2}$" squares. The vertical threads in the frame are numbered from 1 to 23, and the horizontal threads are identified by the letters of the alphabet.

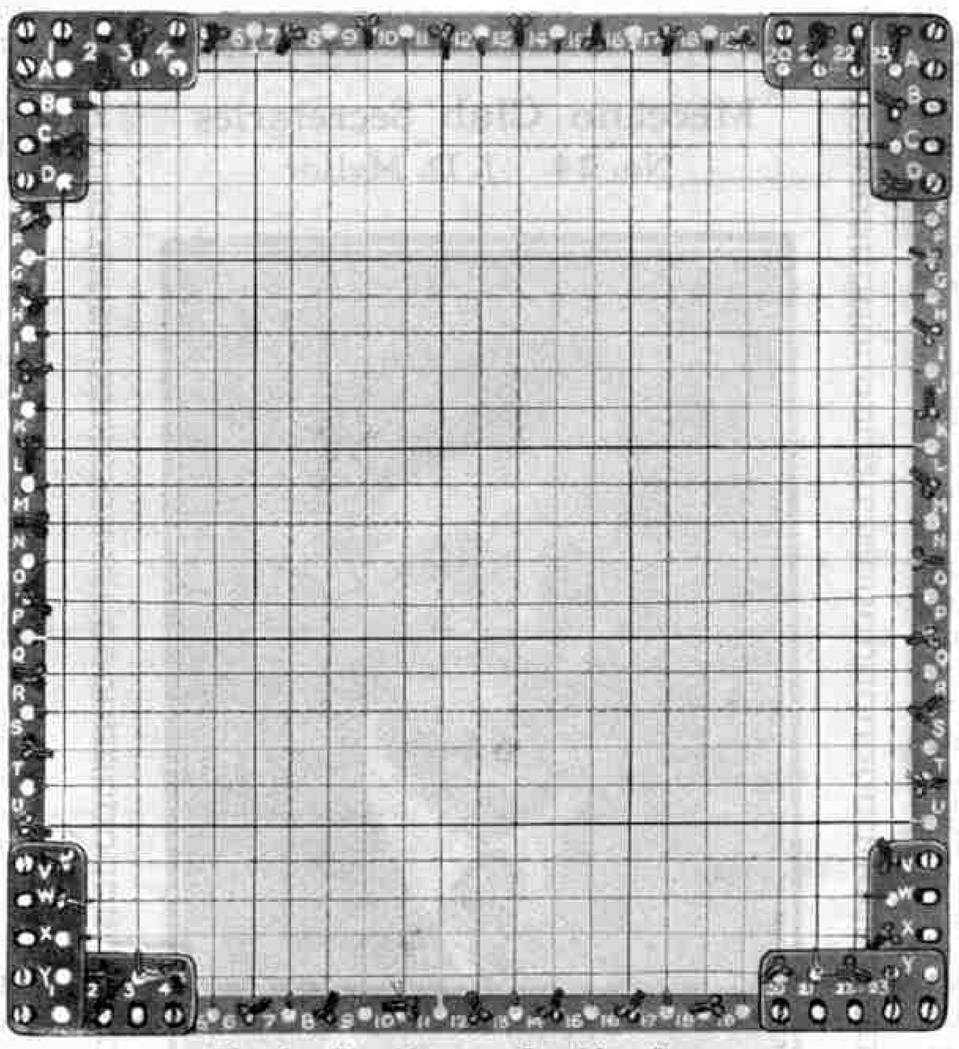


Fig. 1. The Meccano Graphing Screen.

When it is required to make in a note-book, such as the Meccano "*Engineer's Pocket Book*," a reduced sketch of a large drawing, the graphing screen is placed over the drawing and the graph paper of the note-book numbered off to agree with the numbering on the screen. It is then quite a simple matter to make an exact copy of the large drawing, for by noting the positions where the lines of the large drawing meet the vertical and horizontal threads of the screen, and making corresponding marks on the graph paper of the note-book, all possibility of error is avoided.

The graphing screen shown in Fig. 1 is built up from four $12\frac{1}{2}$" Strips and eight $2\frac{1}{2}$" Flat Girders, two Girders being bolted in place at each corner to keep the frame square. Next comes the threading of the screen. If desired one colour of thread may be used throughout, but it is better to employ a number of different colours. In the Meccano screen, red, blue, yellow, white and black threads are used, and are arranged in the following manner. White is used for thread No. 1; No. 2 is red, No. 3 blue, No. 4 yellow, and No. 5 black. This sequence is then repeated until the screen is complete in both horizontal and vertical directions. The contrasting colours of the threads when arranged in this manner stand out very clearly, and make the accurate use of the screen much easier.

It is particularly important, if really accurate results are to be obtained, that every thread of the frame should be kept absolutely taut; and for this reason it is not sufficient merely to tie the ends of the threads to the frame at each side. After considerable experiment the following method of securing the threads was devised, and in spite of its simplicity it has been found to work very effectively.

Each thread is attached as follows. A length of 28 in. of thread is taken and doubled; the loop thus made is passed through one of the holes in the frame, and the thread ends are passed through this loop. This secures the thread to one hole. Next, the two ends are taken to the corresponding hole at the opposite side of the frame, passed through the hole, and fixed securely by means of a knot tied about $\frac{1}{4}$" beyond the hole. Between this knot and the hole, and between the two threads, are passed the two rings of an ordinary hook dress fastener, such as may be obtained from any draper. The thread should pass between the two rings of the hook and the small raised part on the inner portion of the hook. Any superfluous thread is cut off, and the hook is twisted round with the tip of the finger until the thread is taut. In this manner every hole in each Strip composing the frame is joined to the hole opposite to it by a twisted thread, and these threads form the screen.

In order to tighten any thread that subsequently may become slack, it is only necessary to place the finger on the bent portion of the hook and twist the hook in a clockwise direction until the required degree of tautness is attained.

When every thread has been placed in position and adjusted to the correct tension, the screen is ready for use.

The first step is to mark out the squared paper in the notebook to correspond with the numbering of the graphing screen. Then, to "graph" a drawing, it is merely necessary to note in which square or squares each section of the design falls when the screen has been placed over it, and to draw in the necessary lines in the corresponding squares on the page of the note-book. With a little practice this becomes very easy, and a drawing can be reproduced with great speed and accuracy. For instance, suppose that the screen is laid over a diagram of a large breakdown crane, and it is noticed that the tip of the jib of the crane is closest to thread "J" in a vertical direction, while the nearest point in a horizontal direction is thread 5. The position of the tip of the jib is thus fixed as "J5," and a mark is made at this point on the squared paper.

The position that the base of the jib takes up when covered by the screen should next be noted, and a dot made with the pencil at the corresponding point on the ruled sheet of the notebook. The graphing is then continued by making pencil marks on the ruled paper to correspond with each of the more prominent positions on the large diagram. It is of course not necessary to dot in every feature of the large drawing, as small parts such as chimneys, cranks, buffers, axle boxes, etc., can be sketched in freehand once the main lines of the machine have been obtained.

After the "dotting in" process has been completed the pencil marks are joined up and a reduced copy giving the principal features of the original drawing will result. The various smaller details are then drawn in, and it will be found a simple matter to do this once the principal proportions have been accurately graphed.

The Meccano Graphing Screen is suitable for making drawings on a reduced scale only, and it cannot be employed for enlarging purposes. When it is required to prepare an enlarged copy of a drawing, the Meccano Pantograph should be used. Details for building this model will be found on page 70 of the 5-7 Instruction Manual.

"One New Member Every Month"

The winter sessions have now begun and after interesting discussions of the splendid holidays they have spent, and of the many remarkable things they have seen on their travels during the holidays, club members are settling down to indoor work, while Guild members who are unable to join in the pleasures of club life are also returning with renewed energy to their favourite hobby. My correspondence with the Leaders and secretaries of clubs, and indeed with all Guild members, shows that enthusiasm runs high and a very successful season is promised. I should like to make 1932-33 a record year in the history of the Guild, and success in this aim is assured if every member does his utmost to extend its influence among his friends.

One of the most characteristic features of Meccano boys is that they wish to share with others the pleasures they derive from their favourite hobby. The result has been that the best recruiting agents for the Meccano Guild have always been the members themselves, and in order to encourage them to new efforts I have made a change in the conditions of award of the Recruiting Medallion. This is now presented to members who persuade three of their friends to join the Guild, and success in recruiting three additional new members, making six in all, is rewarded by the engraving of the member's name and the words "Special Award" on his Medallion.

Under the new scheme a member wishing to win a Recruiting Medallion must secure his three new members within a period of three months, and he has a further allowance of three months in which to obtain the additional recruits he requires to earn the higher award. Energetic members of the Guild who keep a keen lookout for opportunities of being of service should fulfil these conditions without difficulty. and their slogan for the coming session must be "One new member every month."

Encouraging Recruits

I should like to give just one word of warning. It is not sufficient merely to enlist a recruit; he must be converted into an enthusiastic and valuable member. This can only be done by making him feel by word and deed that he has joined a great brotherhood, every member of which takes an interest in his progress, and is ready to discuss with him Guild matters and other topics of interest to Meccano boys.

A point that should not be overlooked is that every member who has secured six recruits has laid the foundation of a Meccano club. Many of the most successful of these organisations began in the informal assembly of a few members of the Guild brought together by a recruiting campaign organised by one of them. As each member in turn introduced more Meccano boys the association increased in numbers until eventually it became necessary to obtain a club room in which to hold meetings. The formation of a club in this manner is the natural result of a well-organised recruiting campaign.

Meccano Club Secretaries

No. 24. J. D. Mellor

J. D. Mellor is the energetic and capable secretary of Whitgift School M.C., which was affiliated in March, 1929, and quickly became a recognised school institution. The models constructed by members are always well designed and greatly impress visitors to the club's Annual Exhibition. Inter-club Contests with the Whitgift Middle School M.C. are interesting features of the programme.

Joint Meetings of Meccano Clubs

Year by year the tendency towards co-operation between neighbouring clubs makes itself more evident. This has shown itself in the exchange of visits on the occasion of Exhibitions or concerts, and also in the arrangement of joint meetings, when the programmes have consisted of inter-club model-building contests, debates, or matches at table tennis or other indoor games. The tendency to work together is noticeable among clubs in Australia, South Africa and other overseas countries as well as in Great Britain, and I can imagine nothing that is more likely to give members a cheerful and happy time than one of these friendly meetings.

Whenever two clubs have met in this manner, I have invariably received many delightful letters from those taking part in them, and in these the writers have paid willing tribute to the courtesy of the officials and members of those who have been either their hosts or guests. I hope that during the coming winter sessions many more visits of this kind will be arranged, for such an event is bound to be a success, since it is sure to strengthen the feeling that Meccano boys have many interests in common and to prove that the spirit of the Guild and enthusiasm for its aims is in the minds of all those who take part.

Coming Events

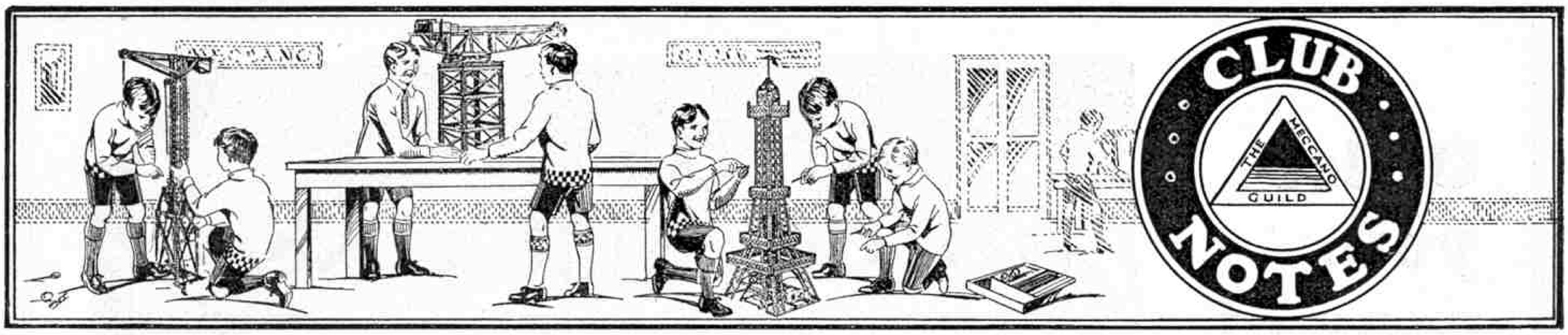
During the Christmas and New Year season many clubs hold Exhibitions, concerts and open meetings at which visitors are welcomed. The appearance in the *"M.M."* of an announcement of an event of this kind is an excellent means of attracting the attention of Meccano boys and others interested who live in the neighbourhood, and therefore of ensuring a good attendance, and I shall be pleased to include such announcements on this page.

In order to avoid disappointment, secretaries who wish me to give notice of their arrangements should forward details as soon as possible. Announcements to appear in the issues for December, 1932, and January, 1933, should reach me not later than 20th October and 20th November respectively.

Proposed Clubs

Attempts are being made to establish Meccano Clubs in the following places, and boys interested in becoming members should communicate with the promoters, whose names and addresses are given below:—

AUSTRALIA—Donald Hay, Barnard Street, North Adelaide.
GALWAY—William Glennon, St. Patrick's Avenue.
HEREFORD—F. Bromage, Thornycroft, Kyrll Street.
HERTFORD—S. F. Roberts, 13, Bengeo Street.
LONDON—R. Carrington, 49, Russell Avenue, Noel Park, Wood Green, N.22.
NEWARK—Mr. Richard S. Miller, 2, Wellington Road.



Hendon M.C.—The club room has been completely overhauled, cleaned and decorated, and club property generally put in order, a strenuous recruiting campaign being carried on while the club room was closed for ordinary activities. Plans are being made for visiting other clubs during the coming winter. A few visits of this kind made during the winter sessions of 1931-32 were very successful, particularly that to the joint Exhibition of the Harlesden and Willesden clubs. Club roll: 12. *Secretary:* E. V. Woodward, "Adelaide" 36, Heming Road, Edgware, Middlesex.

Maidstone M.C.—The meeting following a visit to a Pumping Station was devoted to the construction and demonstration of models of Beam Engines seen. Cricket was taken up during the summer, the most exciting matches being those between the club and the local Branch of the H.R.C. Early preparations for an Exhibition to be held this month also have been undertaken. Club roll: 13. *Secretary:* I. Elbourn, 19, Old Tovil Road, Maidstone.

Gate House M.C.—The Exhibition was very successful. Proceedings commenced with demonstrations on the layout of the Hornby Railway section, and this was followed by the opening of the Meccano Model Fair. The working models included in this were splendidly built, and were placed in appropriate scenery, while music from a mouth organ played underneath one of the tables added to the general effect. Fretwork models also were on view and visitors took part in numerous competitions. The Exhibition concluded with plays performed by members, and a Punch and Judy Show. The usual outdoor work has been continued and the new Photographic Section has made excellent progress. Club roll: 12. *Secretary:* E. Hawkins, Gate House, Ingatestone, Essex.

Plymouth M.C.—The most recent issue of "*The Gear Box*," the club magazine, maintained the high standard of its predecessors, the notes on local railway and tramway topics being particularly interesting. Model-building Evenings have been devoted to the construction of Aeroplanes and Tramcars, and visits have been paid to a local Printing Works, the Laira Engine Sheds, the Burrator Waterworks and the track of the former Plymouth and Dartmoor Railway. A chair and part of a rail of this pioneer line, now abandoned, were found and have been placed in the club's Museum. Club roll: 57. *Secretary:* G. Symons, 6, Holland Road, Peverell, Plymouth.

East Hull M.C.—This club was formerly known as the "Newcomen M.C." An excellent programme of Model-building Evenings, Lectures and Debates is being followed, and a novelty of Model-building activities is that members pass their models to others for criticism, improvements and additions. An interesting recent event was a visit to the Hull Municipal Aerodrome, where members were shown round by an official of the Hull Aero Club. The machines on view included a Gipsy Moth and a Puss Moth. The controls and navigating devices of these were fully explained and one of the members was given a flight. Club roll: 11. *Secretary:* H. Acklam, 103, Newcomen Street, Hull.

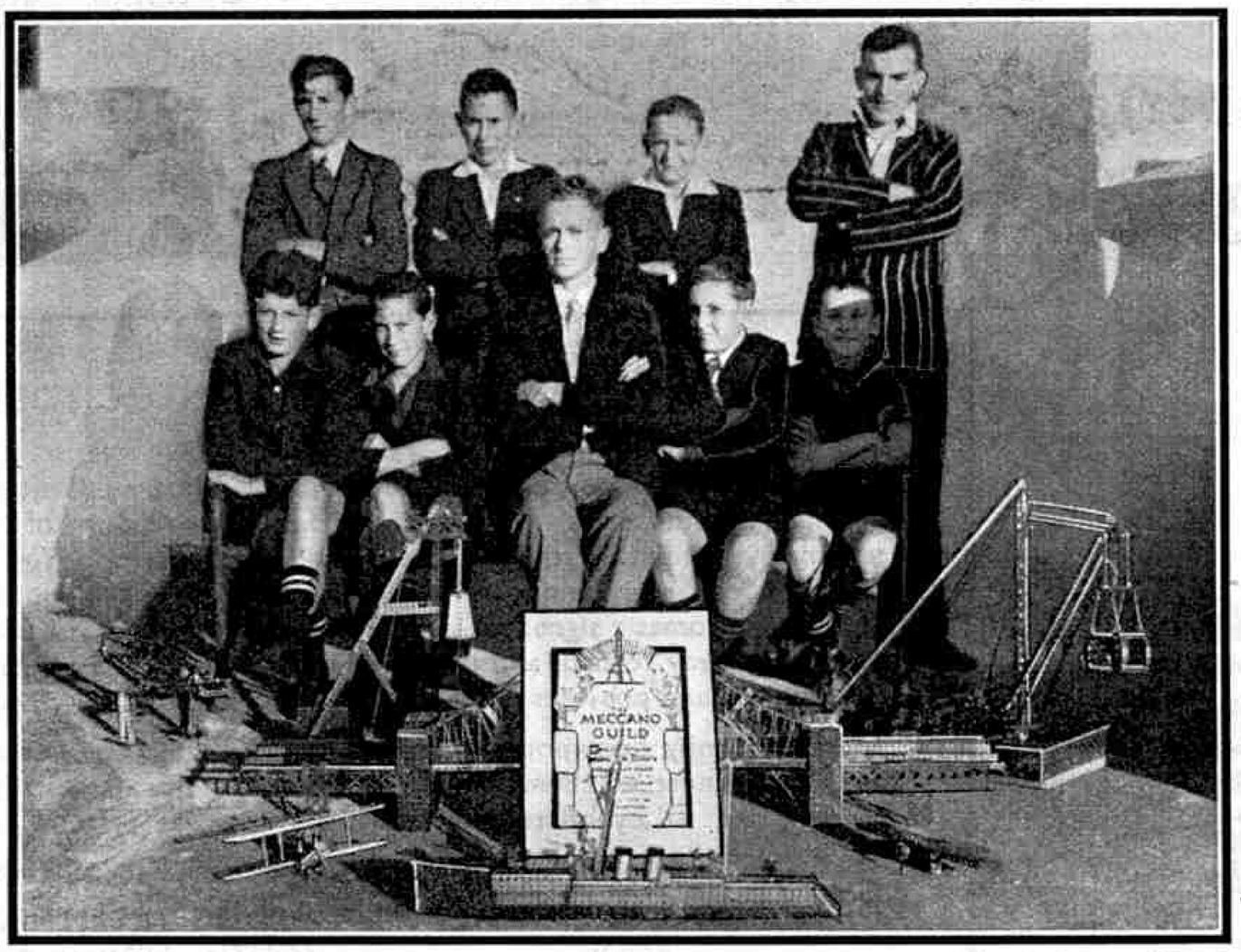
Old Charlton M.C.—Hat Nights and Mock Trials have been popular items in the programme, and a lecture on "*Subway Engineering*" by Mr. H. Crookshanks was greatly appreciated. Alternate meetings have been devoted to Model-building and Walking Tours. On one ramble more than 15 miles were covered, and on a second Epping Forest was visited. Club roll: 21. *Secretary:* B. Stevens, 53, Mount Street, Charlton, S.E.7.

Chertsey M.C.—Much amusement was caused by an exciting Treasure Hunt, the final clue being too difficult for the members, all of whom reached the finishing point but were unable to find the treasure. A modified Contest ended in the joint victory of two members, who shared the prize. Visits have been paid to Weybridge and Addlestone Stations on the S.R., where interesting layouts were studied. The club is now being divided into three sections for Model-building Competitions and other contests, and recruits for the senior section are now urgently required. Full details may be obtained from the secretary. Club roll: 26. *Secretary:* E. V. Brown, Arbon Grove Cottage, Lyne, Near Chertsey, Surrey.

St. Peter and St. John's (Exeter) M.C.—A particularly interesting event has been the dismantling of the club's Meccano Tramcar, constructed six years ago. This club is remarkable for the number of large models always available for study and working, the chief features at present being two large and well-equipped Workshops. In addition, two Overhead Stations have been built from Meccano parts for installation on the club's Hornby Train layout, and other models constructed have included a Double Headed Crane, to be driven by a clockwork motor for the Meccano Steam Engine, built by Mr. M. C. Hodder, Leader of the club, a large Derricking Crane and a Merry-Go-Round. A Tar-spraying machine also has been made, while other devices introduced have included one for measuring distances on Maps and a Revolution Counter for the model workshops. Club roll: 21. *Secretary:* J. Blaker, c/o 60, Elmside, Exeter.

Kendal M.C.—Cycling has occupied members' attention during the summer, trials on the lines of motor cycle events being arranged. The club is fortunate in its position, and several very enjoyable excursions to Bowness and other Lake District centres were organised. Models built during the summer session include large cruisers and other battleships. Air-gun shooting is very popular. A notable feature is that the copies of the "*M.M.*" owned by the club are in constant demand. Club roll: 13. *Secretary:* L. Haslam, c/o 34, Park Avenue, Kendal.

Middlesbrough M.C.—The Fifth Annual Parents' Evening was remarkably successful. Councillor S. Levy gave an interesting address on "*Citizenship*" and prizes won during the session were presented. Mr. James Senior, Assistant Leader, received a Fountain Pen given in recognition of his long and valuable service to the club. Cricket and cycling have been the chief recreations during the summer. Club roll: 36. *Secretary:* R. Rowlatt, 3, Blenheim Villas, Longlands Road, Middlesbrough.



A sunny scene in New Zealand. Our photograph shows members of the Hawera club, which was affiliated in June, 1930, and is remarkable for the enthusiasm shown in Model-building Competitions. These and other contests are fought out with remarkable keenness and models built by members invariably attract great admiration when exhibited at local shows.

AUSTRALIA

Kookaburra M.C.—The general position is being improved, and Model-building Evenings are held weekly. Members are encouraged to take interest in national events, and special reference is made at each meeting to notable Australian engineering works or aviation records. Crystal Wireless Sets are being constructed. More members are required and the secretary will be pleased to receive applications from those who are interested. Club roll: 10. *Secretary:* R. Culley, 8, Eastwood Terrace, Eastwood, South Australia.

CANADA

Rosemount (Regina) M.C.—The Leader, Mr. J. J. Favelle, has kindly provided a club room, and regular meetings for Model-building and other hobbies are being held. Members have jointly constructed a model of a Machine Shop, equipped with a Bench Saw, Drill, Lathe and a Punching Machine. A three-storey Warehouse with two lifts is now being built. Club roll: 17. *Secretary:* J. E. Watson, 974, Athol Street, Regina, Sask.

DENMARK

Copenhagen M.C.—Cycle runs have been the chief feature of the summer programme, and on one of their excursions members enjoyed a long walk, and a sail on a lake near the summer home of one of the members. Indoor activities have included the building and demonstration of Meccano Cranes and Excavators, while Model-building Competitions and Stamp Evenings have been held. About 30 models built by members recently were exhibited in the windows of the local Meccano dealer. Club roll: 11. *Secretary:* F. Severin, Rud Berghsgade 17, Copenhagen.

ITALY

International Diplomatic (Rome) M.C.—Affiliation has been secured and members are very enthusiastic. The subjects of recent Model-building Contests have been Sir Malcolm Campbell's "*Bluebird*" and a modern Electric Locomotive. An extensive walking and camping tour was the chief feature of the programme in the holiday months, successive camps being established at Annecy in France and on the shores of Lake Geneva in Switzerland. Club roll: 16. *Secretary:* Masao Yoshida, Imperial Japanese Embassy, Viale della Regina 236, Rome, Italy.

SOUTH AFRICA

Observatory and District M.C.—Fretwork has now been adopted as an additional hobby. Special interest attached to a debate on "*Coal v. Oil.*" Many visitors were present and they expressed great admiration for the speeches of the members who opened the debate. *President:* Mr. G. E. Barrett, P.O. Box 1247, Capetown.

Clubs Not Yet Affiliated

Regina M.C.—Recruiting has been active since the organisation of the club, and an attractive programme is being prepared for the winter sessions. Excellent models have been constructed by members. These were exhibited in the Regina Boys' Fair, where they attracted special attention. The secretary will be pleased to hear from those interested in the club, for which recruits are wanted. *Secretary:* Mr. F. B. Gamble, Boys' Work Secretary, Y.M.C.A., Regina, Sask.

Westmount (Montreal) M.C.—This newly established club has already secured a great success, models built by members having been awarded six prizes at the recent Montreal Hobby Show. More members are required, and the secretary will be pleased to receive applications from Meccano boys living in Montreal. *Secretary:* Mr. Murray, Westmount Y.M.C.A., 4585, Sherbrooke Street, W. Montreal.

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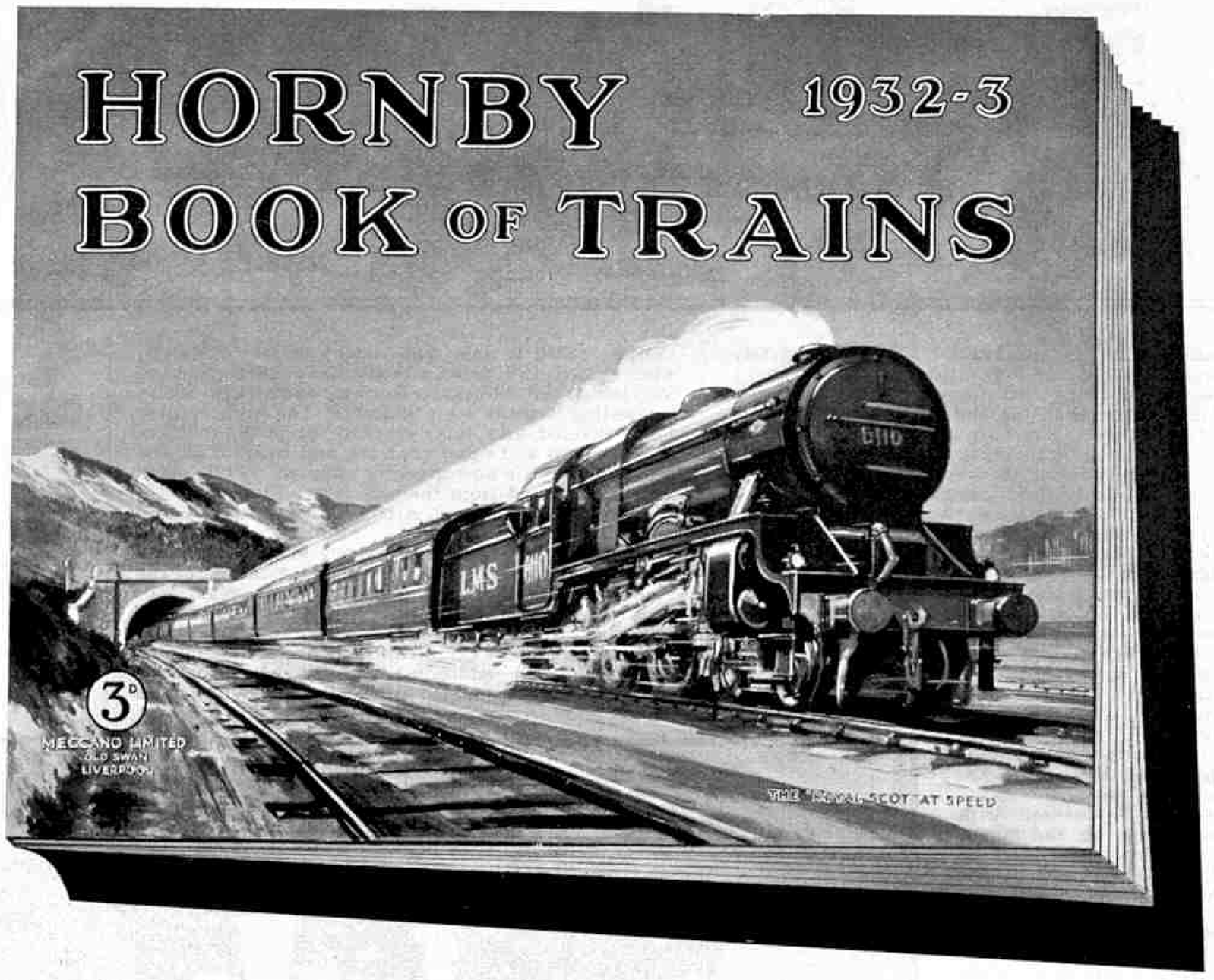

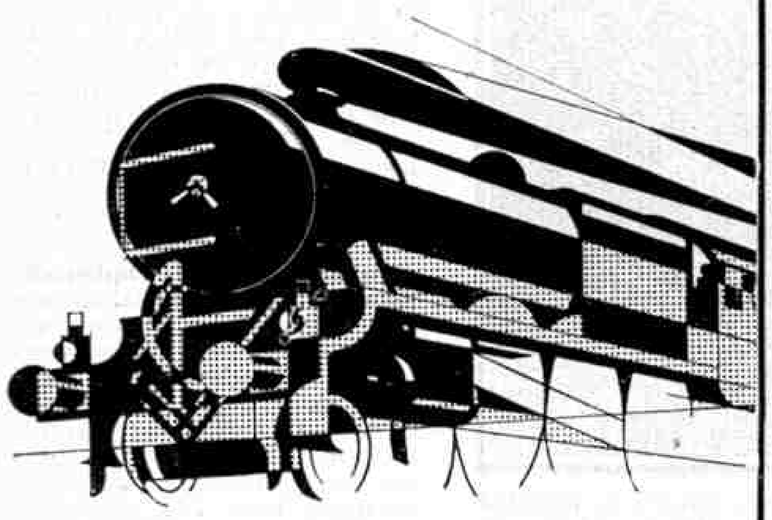

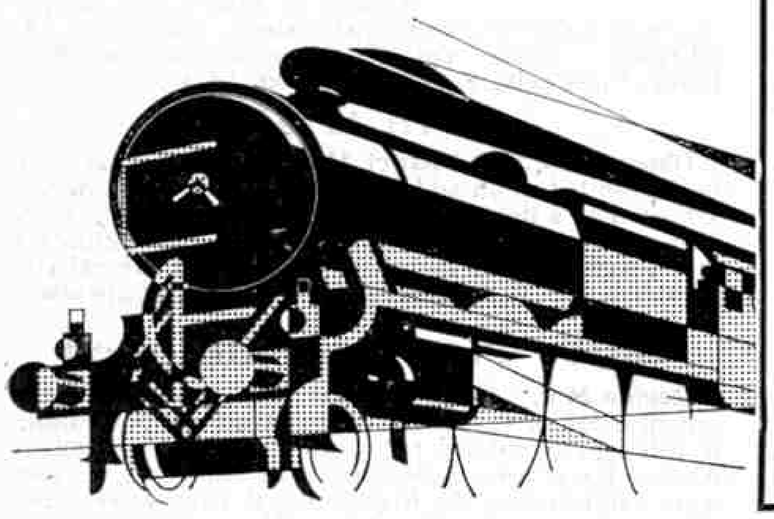

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Overseas Agencies:

NEW ZEALAND: Models Limited, P.O. Box 129, Auckland (Third Floor Paykel's Building, Anzac Avenue)

SOUTH AFRICA: Arthur E. Harris, 142, Market Street, Johannesburg (P.O. Box 1199)

CANADA: Meccano Ltd., 34, St. Patrick Street, Toronto

MECCANO LTD. (Dept. A.M.) OLD SWAN LIVERPOOL

Branch Notes

STAMFORD.—Track meetings provide great fun, although the track has to be taken up at the end of each meeting. The L.N.E.R. Goods Yard at Peterborough has been visited. There members were allowed to enter the cab of a booster-fitted locomotive, and were interested in the grinding of locomotive wheels on a giant lathe. Secretary: E. J. Belton, 43, Casterton Road, Stamford.

HANWELL BROADWAY.—Visits have been paid to Southall Station, interesting locomotives usually being seen on these occasions. All members are busy on special constructional work, building stations, signal boxes, platforms and other accessories. Signalling is being studied and members are learning the bell code. There is room for a few new members and the secretary will be pleased to hear from those interested. Secretary: C. Gray, 3, Boston Road, Hanwell, W.7.

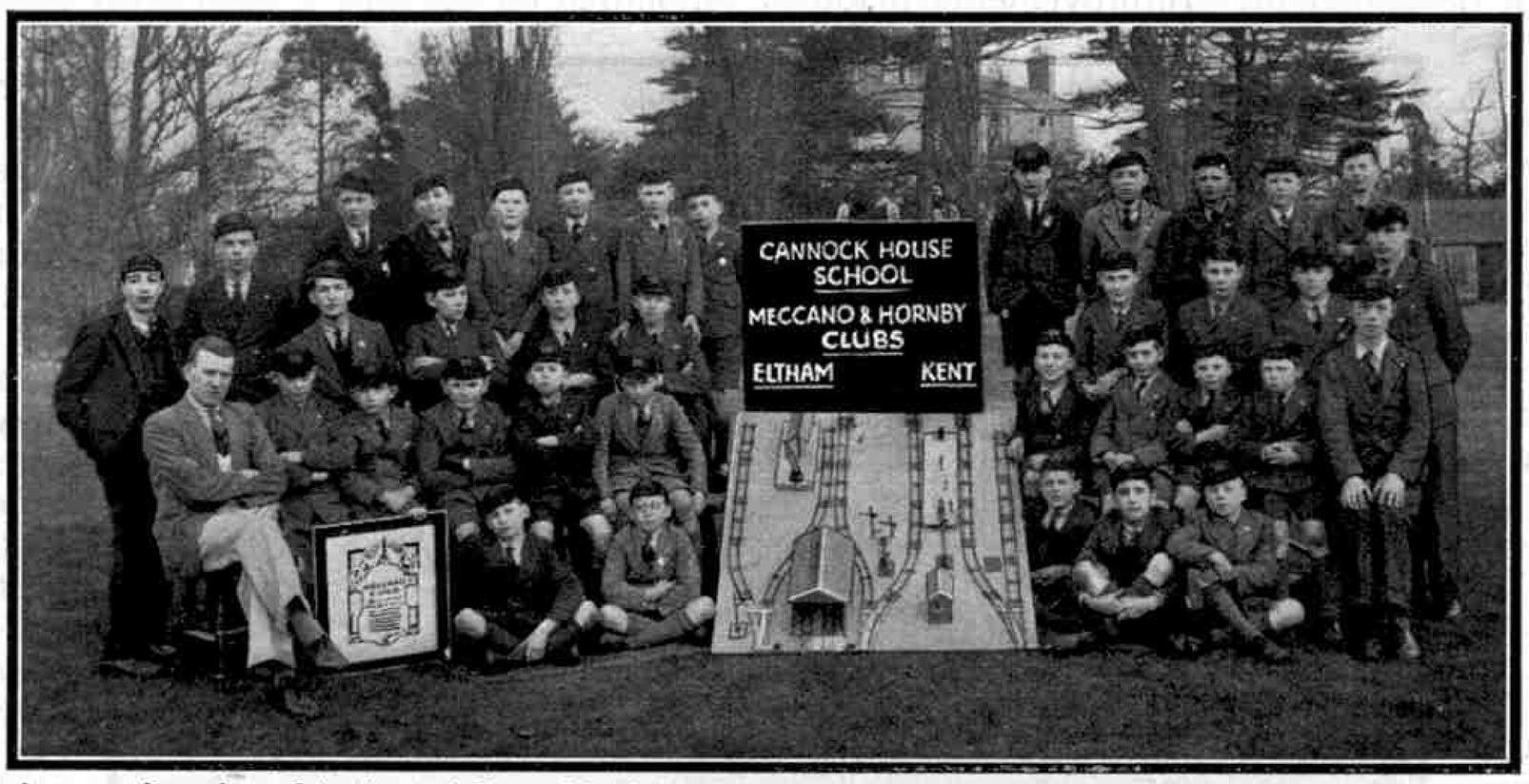
SAINT NICHOLAS (BIRMINGHAM).—Track meetings are the chief features of the programme, a new layout being designed at regular intervals. Visits have been paid to New Street and Snow Hill Stations, and variety was provided by an excursion to Stratford-on-Avon during the Festival when members saw a performance of "*Julius Cæsar*" in the newly completed Shakespeare Memorial Theatre. Secretary: J. E. Wilson, 23, Meadow Hill Road, King's Norton, Birmingham.

WIMBORNE GRAMMAR SCHOOL.—An electric track has been added to the Branch layout, which is now partly electric and partly clockwork in operation, trains on the two sections being run to fit in with each other. Further accessories, such as Spring Buffers, Locomotive Lamps, and Modelled Miniatures are being added, the Hornby miniature station staff being greatly admired by members. A novel Exhibition has been held, the Branch room being open to visitors for a long period. The first day's attendance was low, but as the earlier visitors informed their friends of the wonderful attractions on view, the attendance became more satisfactory. The track has been overhauled and re-arranged. Secretary: J. K. Bennett, 120, Newington Causeway, London, S.E.1.

WHITGIFT.—Meetings for practical work on the Branch track have been held regularly, but variety has been provided by cricket matches, visits and excursions, one of the most interesting of these being a day trip down the Thames. An interesting visitor was Mr. R. Premchard, of Bombay, India, who is making a short stay in this country and hopes to found a Branch on his return to India. The operation of the Branch was fully explained to him. Secretary: J. D. Mellor, 71, Birdhurst Rise, South Croydon.

BOWDON.—A new track has been designed and laid down, the last nail being driven in with due formality by Mrs. Ormerod, Chairman of the Branch. A "Riviera Blue" Locomotive then made the first circuit of the track, hauling four Hornby No. 1 Pullman Coaches. The new track is admirably adapted to timetable working and members are becoming very expert. Games have been played regularly and meetings have been livelier since the formation of the Branch orchestra, the instruments including three drums, four mouth organs and a piano. Secretary: N. M. Makin, Spring Bank, Ashley Road, Altrincham, Cheshire.

WOODFORD.—Recent meetings have been chiefly devoted to operations on an excellent outdoor track about 50 ft. in length. In addition, a clock golf tournament has been played and other outdoor activities have included cricket, cross-country runs and visits. Secretary: J. H. Skelt, Walberswick, Woodside Road, Woodford Wells, Essex.



A group of members of the Cannock House School, Branch No. 217. Chairman, Mr. F. Paul Montagu, B.A.; Secretary, D. Wynbergen. The Branch was incorporated in February of this year. It is conducted in conjunction with a Meccano club and both organisations have made excellent progress. A large permanent layout has been constructed, consisting of two main lines with sidings and station, and very realistic operations are carried out.

AUSTRALIA

SYDNEY.—A new baseboard 56 ft. in length has been introduced into the Branch layout. Great care has been taken to have this dead level, and the running of trains on it is a great improvement on former work. New engines, including five brought by Mr. H. H. Matthews, Chairman of the club, have been tested for power and speed, and excellent timetable working is carried out. On one occasion 15 locomotives, 63 passenger coaches and 22 goods vehicles were in use. Secretary: W. J. T. Watson, 595, Parramatta Road, Leichhardt, N.S.W.

NEW ZEALAND

CHRISTCHURCH.—A Branch track representing the line of the N.Z.R. from Timaru to Christchurch has been laid down and colour-light signals made from Meccano parts installed. Regular track nights are held on the layout, and in addition, Meccano Electric Locomotives taking current from overhead wires have been tried and found satisfactory. Secretary: J. C. Fleming, 52, Cowlishaw Street, Avonside, Christchurch.

Branches in Course of Formation

The following new Branches of the Hornby Railway Company are at present in process of formation and any boys who are interested and desirous of linking up with this unique organisation should communicate with the promoters, whose names and addresses are given here. All owners of Hornby trains or accessories are eligible for membership and the various secretaries will be pleased to extend a warm welcome to all who send in their application.

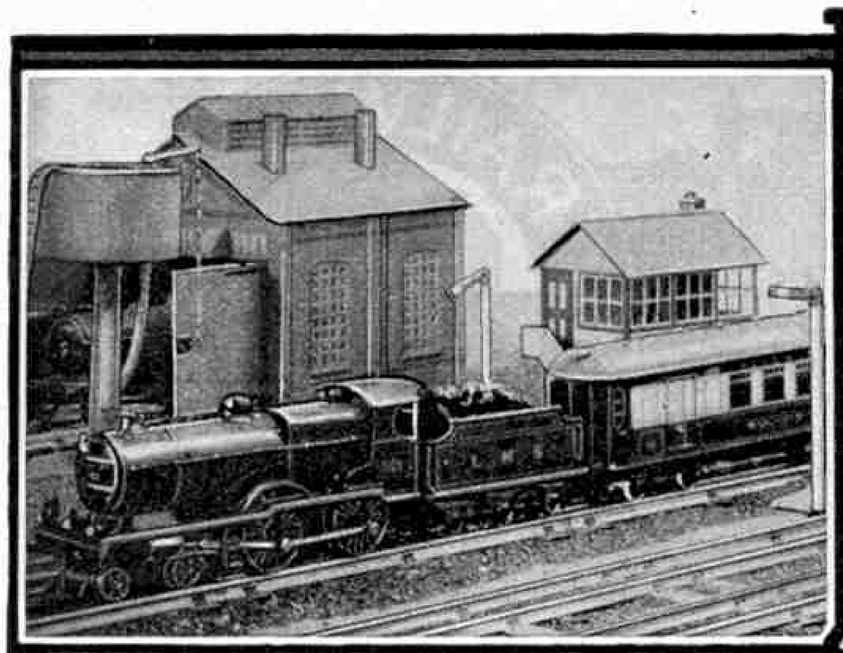
KEIGHLEY—Maurice Fawcett, 5, Upper Calton Street, Keighley.

LINGFIELD—K. Jennings, Amberside, Lingfield.

Branches Recently Incorporated

231. HANWELL BROADWAY—Cyril Gray, 3, Boston Road, Hanwell, W.7.

232. STREATHAM PARK—Mr. Patrick Doyle, 177, Ribblesdale Road, S.W.16.



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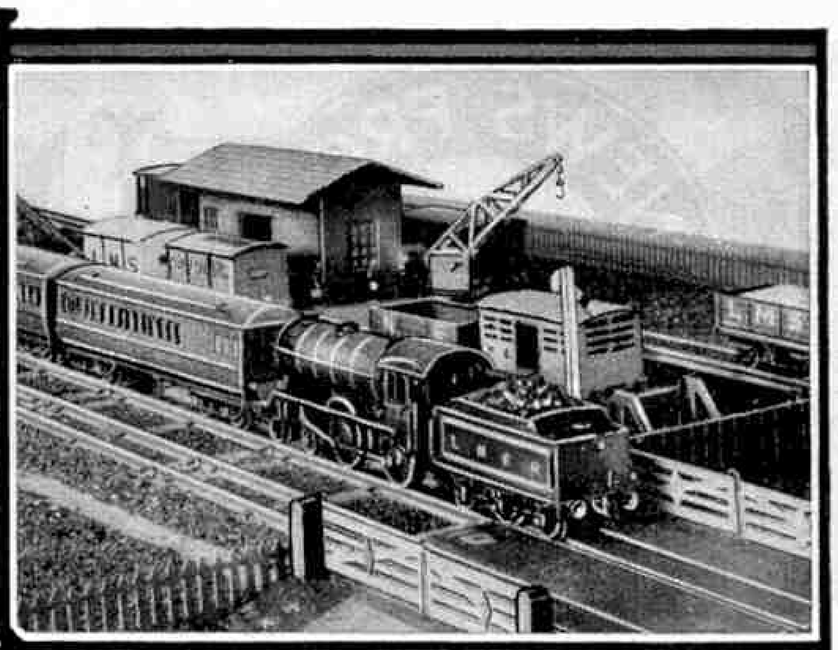
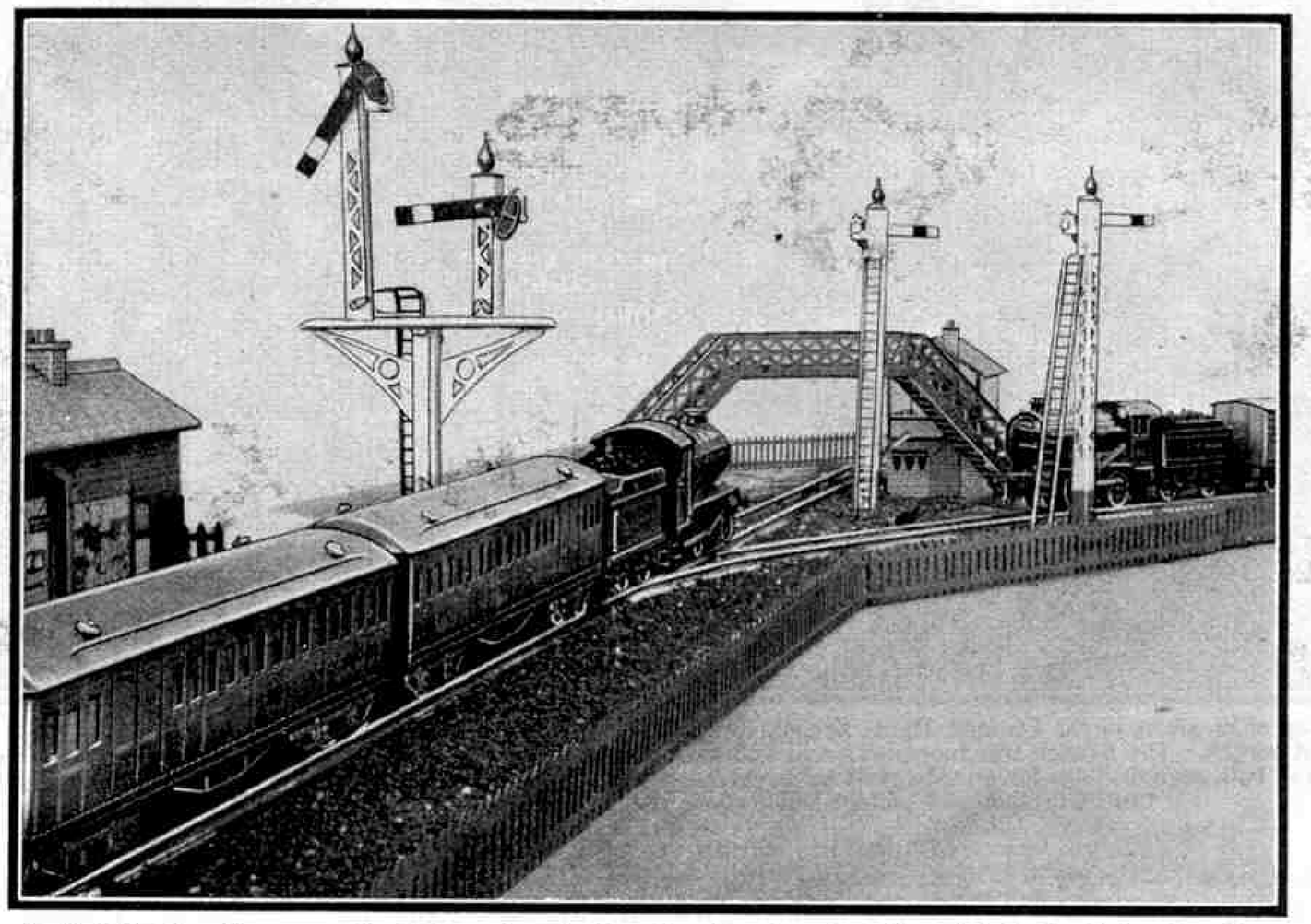


XLVIII.—SIGNALS AND SIGNALLING

SAFETY is the keynote of British railway operation, and our railways can truly pride themselves on the efficiency of the signalling system that allows so many passenger and goods trains to be run on busy lines without mishap. Of course the present system did not spring into being all at once, but it has seen a gradual process of development. Improvements made from time to time have brought it from the haphazard ways of the early days to the mechanical and electrical precision of present methods. On miniature railways, although no lives are at stake, a signalling system is necessary so that the line may represent the real thing as far as possible, both in appearance and in operation. Once the elementary principles are known, this fact and the useful range of signals found in the Hornby Series admit of no excuse for the miniature railway owner neglecting to provide signals, at all events as far as the main line on his layout is concerned, even if sidings and other subsidiary lines are more or less left to their own devices.



A single line junction on a Hornby layout. The Junction Signal protects the points in the facing direction, while they are covered by separate Home Signals for trains approaching the other way.

Real signals are such familiar objects that frequently we do not bother to notice much about them. It will be useful, therefore, to mention the most important features, so that the different parts and their functions may be understood, and the application of signals to miniature Hornby layouts made more interesting. Taking the ordinary semaphore signal of the lower-quadrant pattern—for this is the prototype of the signals of the Hornby Series—we find that it consists of a semaphore arm pivoted on a tall post. At the inner end of the semaphore, that is the pivoted end, there is a casting containing two spectacle glasses, one red and one blue. These are so arranged that when the semaphore is horizontal, indicating "danger," the red glass is illuminated by a lamp attached to the post. To indicate "line clear" the semaphore is lowered—hence the term "lower-quadrant," and the other spectacle is illuminated and so shows green.

The weight of the spectacle casting is such that the semaphore would assume the "danger" position in the event of any connection being broken. There is also mounted on the post a short lever with a counterweight to assist the return of the arm to "danger" when the signal lever in the cabin is thrown back to normal. This weight helps to overcome the resistance of the signal wire, which may extend for a considerable distance between the foot of the signal post and the cabin.

The post itself is usually of wood, but in Scotland and on the Western Section of the Southern Railway metal posts of lattice construction are used extensively. These are particularly attractive in miniature form, and the posts of Hornby Signals are therefore of this kind. For inspection and attention to the lamps, ladders are fitted, and sometimes what is known as a landing or gallery is provided at the top to safeguard the lampman in his sometimes lofty position. To finish off the top of the post a cap or a more or less ornamental finial is fitted, the ball and spike pattern of the latter being a particular favourite, and therefore the one adopted in the Hornby Series.

An interesting detail is the back light and backshade or blinder plate. A small plain lens in the rear of the lamp allows light to show through. When the arm is up at "danger" the light is visible to the signalman if his box is in the rear of the signal, but at "line clear" the light is cut off by the blinder plate mounted on an arm pivoted with the semaphore itself. Where a bridge or other structure is in the way the scheme is not of much use, and therefore electrical repeating apparatus is often used to show the position of the signal arm.

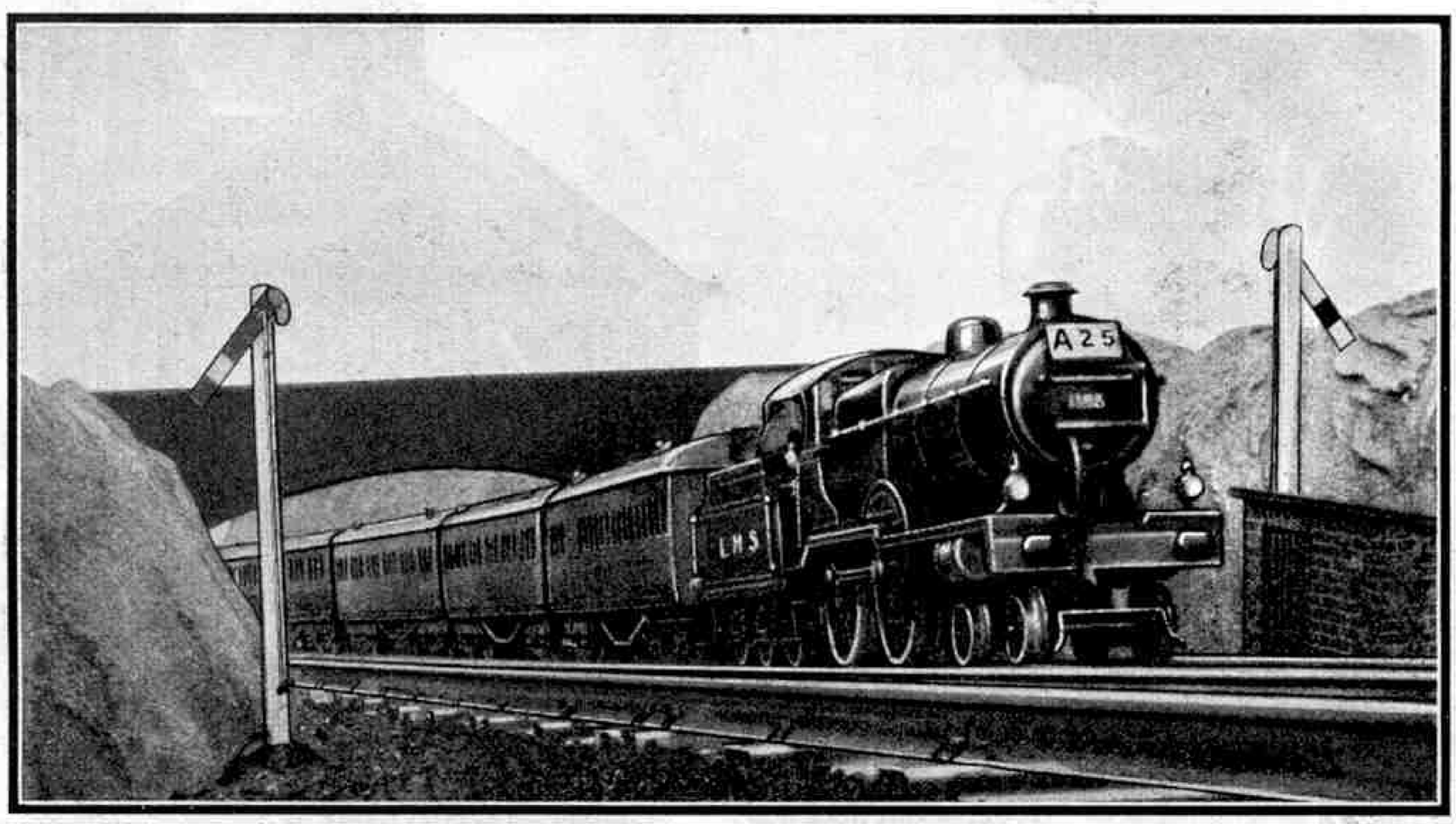
Some signals still retain the old slotted type of post in which the signal arm is mounted on a spindle passing through a slot in the top of the post. This scheme is a survival from the time when semaphore signals were recent innovations, and before the inauguration of the block system. "Line clear" was then indicated by the arm dropping out of sight into the post. Posts of a similar kind are found on sections of the former North Eastern Railway and occasionally elsewhere. The spectacle in this case is separate from the semaphore, but they are necessarily pivoted together. This feature is shown clearly in the lower illustration on this page.

Signal arms are painted red on the side that faces the driver, and white on the reverse, the white stripe at the outer end on the facing side being matched by a corresponding black one on the back.

The ordinary type of signal having a square-ended semaphore is known as a "home" signal, and must not on any account be passed by a train when in the "danger" position. A semaphore having a notched or fish-tailed end is known as a "distant" signal. Its function is to indicate to the driver the position of the "home" signal before he reaches it, so that the slowing down and stopping of the train may be easily effected if the "home" signal should still be at "danger" when the train reaches it. According to conditions, the "distant" signal is usually placed from 600 to 1,000 yds. in front of the "home" signal, and its special function is indicated by the yellow colour of the arm and the orange "danger" spectacle that are now becoming standard, in addition to the usual fish-tailed end.

A very useful range of miniature signals is now included in the Hornby Series. Of the larger types with lattice posts, three are shown in the illustration on page 792. There the single line junction is protected by the necessary signals, and as long as the main line points on a layout are adequately covered, the system may be considered reasonably complete. "Distant" and "home" types are made, so that, where the space available on a miniature system permits, the "distant" may be used in the correct manner. Junction signals are very useful items, and look particularly well when placed in appropriate positions.

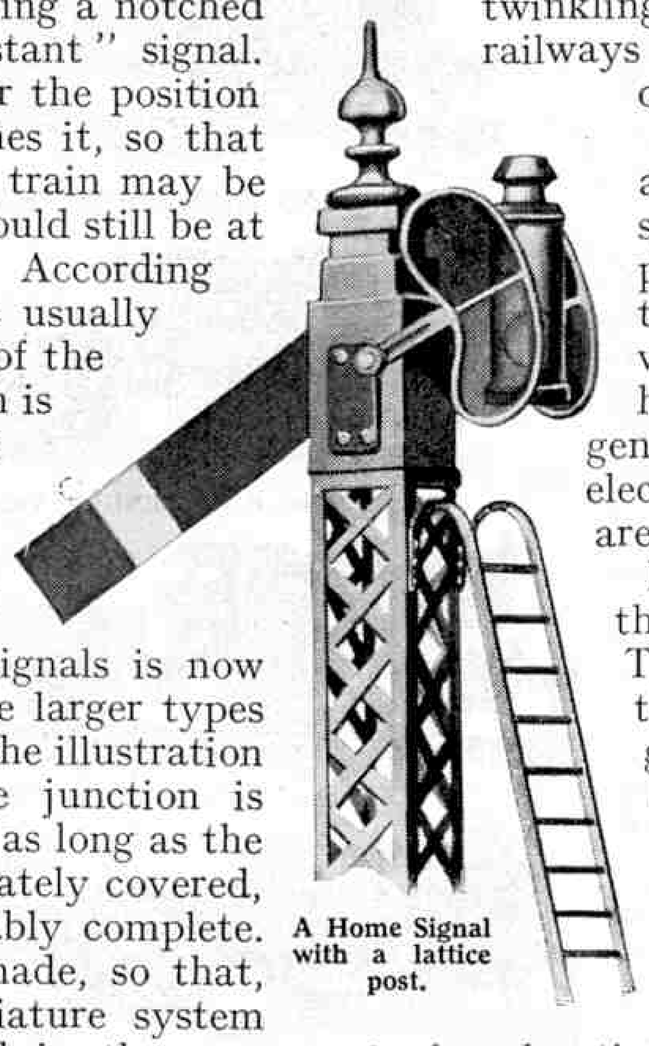
In situations where a section is too short to allow of the proper placing of the "distant" signal, good use may be made of the combined "home" and "distant" Double Arm Signal. This has a "home" semaphore at the top of the post and a "distant" below it, the latter applying to the next "home" signal ahead. In actual practice this "distant" cannot be lowered until the "home" semaphore on the same post is down, and when this goes back to "danger" the "distant" goes with it. The special arrangement made to effect this is known as "slotting," and is carried out in connection with the levers and counterweights that are mounted at the foot of the post.



The chief features of the M Signals are clearly shown in this illustration. These signals are very useful and have a neat and pleasing appearance.

For spanning two tracks the Gantry Signal is an effective accessory, and on the gantry portion itself are mounted four "dolls" or small signal posts, two applying in one direction and two in the other.

Various Hornby signals are now provided with miniature lamp cases arranged to house a flashlamp bulb of suitable power. The wiring is led through the post, and plugs are fitted to the base. These plugs suit the socket fittings of the Flexible Leads provided to connect up these accessories to the power supply by means of the Distribution Box. Thus the twinkling "ruby and emerald" effect seen on real railways at night may now be actually reproduced on a Hornby layout.

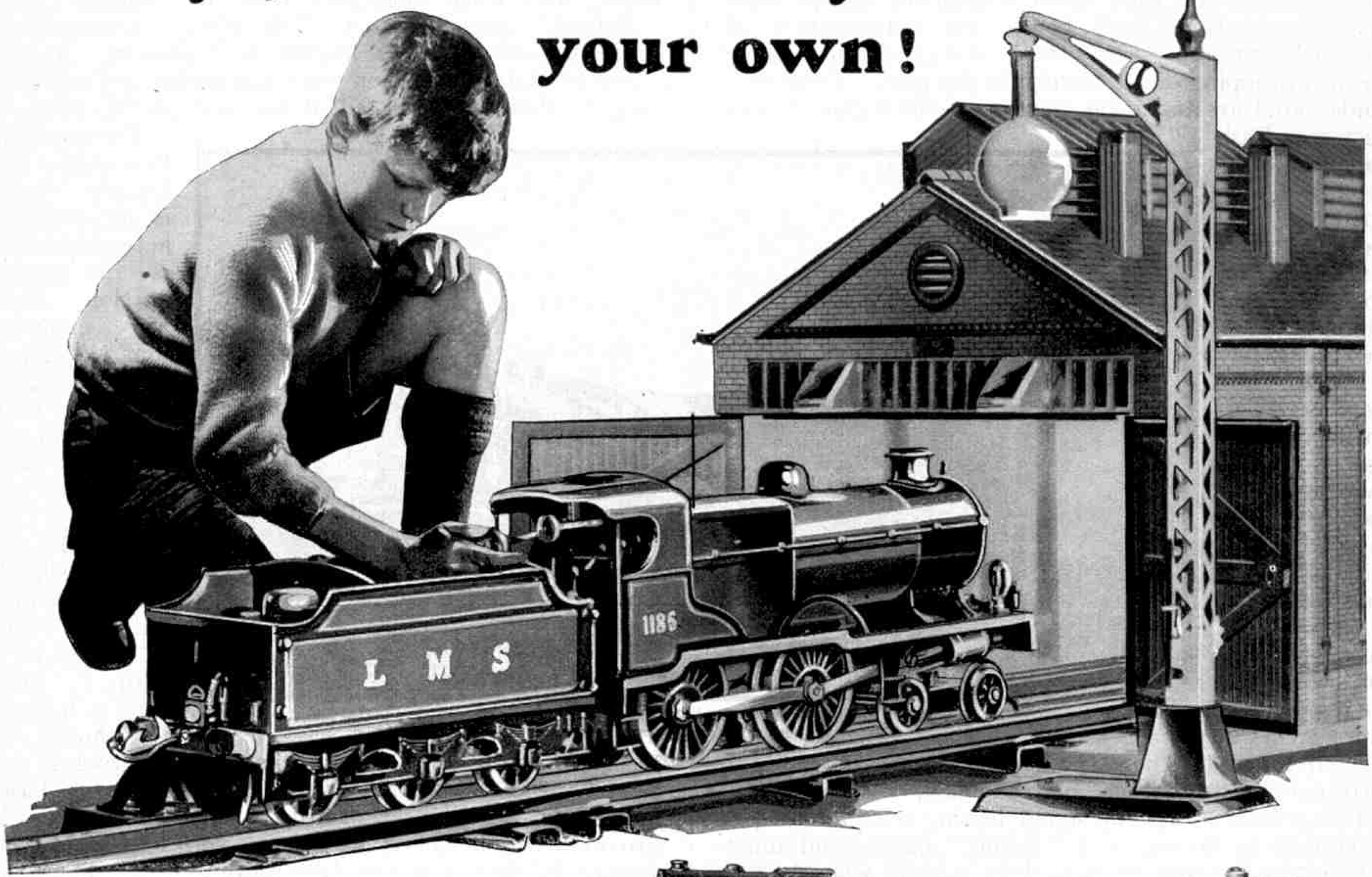


A Home Signal with a lattice post.

The Single and Double Arm Signals are available in two chief varieties known respectively as No. 1 and No. 2. The No. 2 pattern have ladders, lamps and finials, transparent spectacles and other features, whereas the No. 1 kind, which are cheaper, have fewer refinements, but are similar in general style. They are not available wired for electric lighting, for only the No. 2 Signals are so provided.

In addition to these larger Hornby Signals there are the simpler and smaller M Signals. These are very attractively finished, but there are no special fittings on them. Their general construction may be seen from one of the accompanying photographs. They may be used where large numbers of signals are required for the sake of effect, but their operation by hand one at a time is necessarily somewhat tedious. Many miniature railway owners use them for shunting purposes on large layouts, and there is much to be said in their favour for yard use in this manner. Where thus employed a small ring of thin card may be glued to the face of the semaphore to mark the difference between these and main line signals as is sometimes done in actual practice. Only the "home" pattern is made, but if fish-tailed semaphore ends for "distant" signals are required, the thin metal arms may be cut quite easily with a pair of old scissors.

Boys, Start a Railway of your own!



You have spent many happy hours watching real trains; now start a railway of your own and have the thrill of operating Engines, Rolling Stock, Signals and Points on actual railway principles. Everything under your own control.

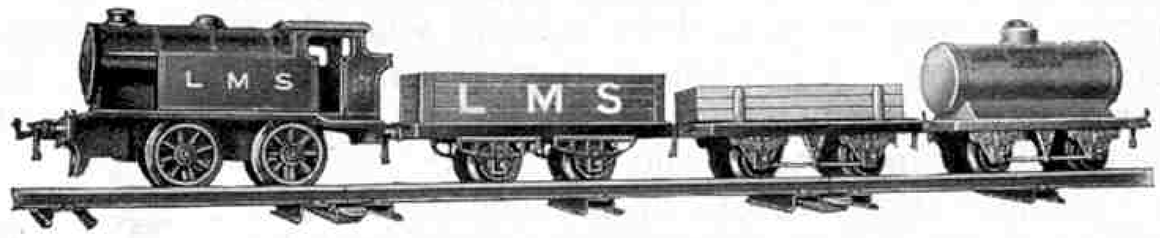
Almost every operation in modern railway practice can be carried out with a Hornby Railway. The Locomotives are the best in the world for length of run and hauling power; the Rolling Stock includes every type in general use and the Accessories provide the final touch of realism. There is an endless variety to choose from.

If you do not possess a Hornby Railway, now is the time to start. Ask your dealer for a copy of the latest Hornby Train Price List.

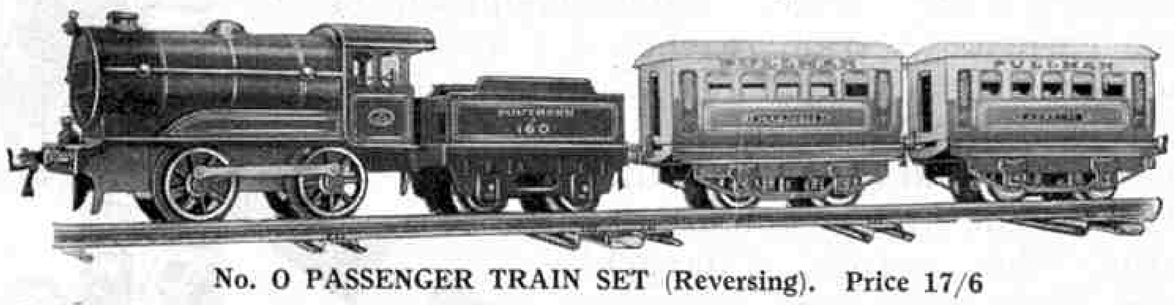
Prices of Hornby Clockwork Train Sets

M0 Goods Set	5/–	No. 1 Tank Goods Set	25/–
M0 Passenger Set	5/9	No. 1 Passenger Set	28/6
M1 Passenger Set	9/3	No. 1 Special Goods Set	32/6
M1 Goods Set	10/–	No. 1 Special Passenger Set	35/–
M2 Passenger Set	10/9	No. 2 Mixed Goods Set	40/–
M3 Tank Goods Set	15/–	Metropolitan Train Set C	45/–
No. 0 Goods Set	18/6	No. 3C Riviera "Blue" Set	62/6
No. 0 Passenger Set	17/6	No. 2 Special Pullman Set	67/6
No. 1 Goods Set	25/–	No. 3C Pullman Set	67/6

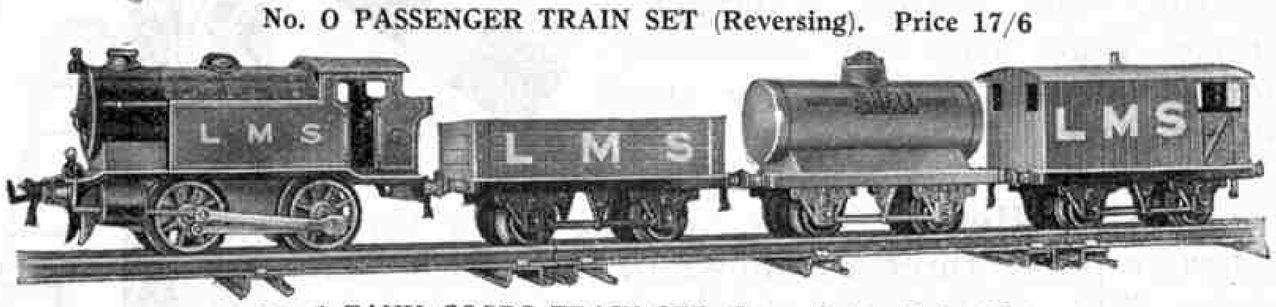
Electric Models at 80/– and 85/–



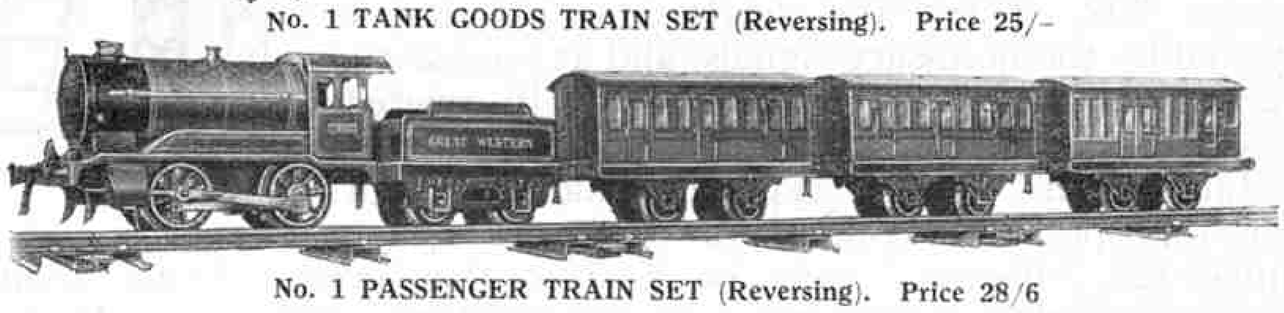
M3 TANK GOODS TRAIN SET (Reversing). Price 15/–



No. 0 PASSENGER TRAIN SET (Reversing). Price 17/6



No. 1 TANK GOODS TRAIN SET (Reversing). Price 25/–



No. 1 PASSENGER TRAIN SET (Reversing). Price 28/6

HORNBY TRAINS

MANUFACTURED BY MECCANO LIMITED, OLD SWAN, LIVERPOOL

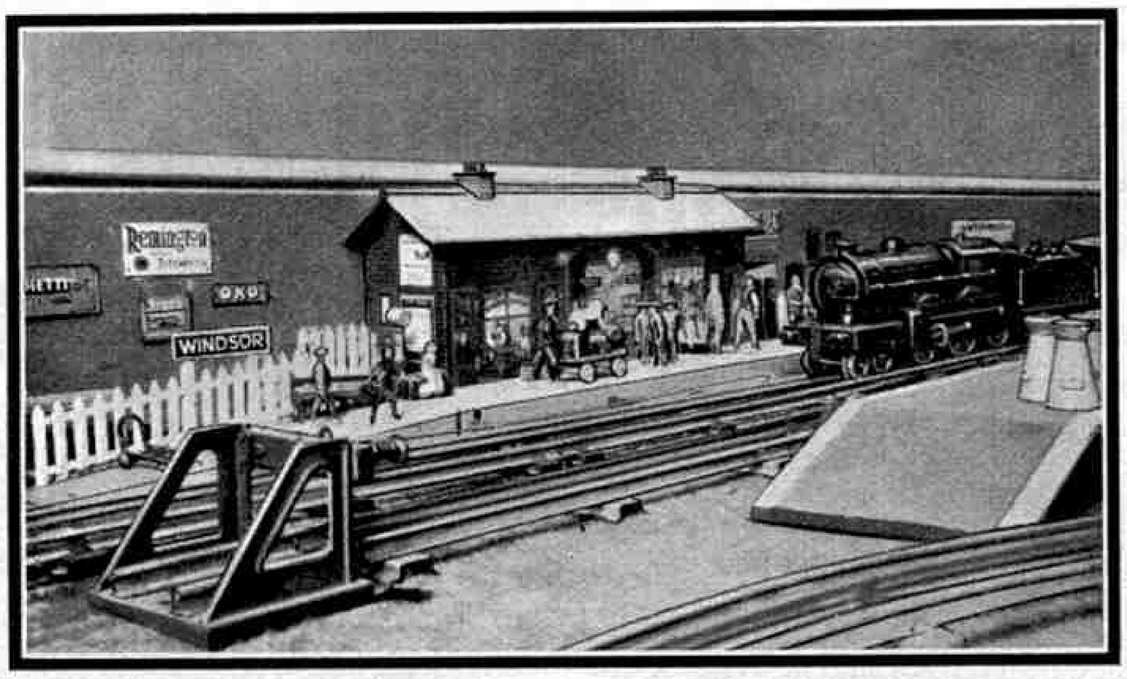
Suggested Hornby Train Improvements

TELEGRAPH POLES

A noticeable feature on any railway journey is the monotonous procession past us—or so it seems—of telegraph poles, placed along the iron way like a row of soldiers. Such a characteristic lineside feature cannot be neglected on a model railway, and there are three variations of Telegraph Poles included in the Hornby Series. The largest pattern is a very good representation of the actual thing, having a circular post, two crossbars and eight insulators. The pole is secured to a stout base, which allows it to be screwed down firmly, as is necessary if it is required to carry actual wires, or for use on a permanent layout.

The other two patterns are classed with the M Series Accessories, and are therefore of simpler construction. The posts are rolled metal, not die-cast, and each crossbar and its insulators are pressed out in one piece and attached to the post by lugs. The base is neat, and although easily hidden in the ballast if required, provides sufficient support for the poles. The two patterns are known as M Telegraph Pole No. 1 and No. 2, the latter being rather higher, but otherwise similar to the No. 1 variety.

When placing telegraph poles on a layout it is important to see that they are situated whenever possible on the side of the line furthest from the operator, so that they do not get in the way of the management of the engines and rolling stock generally. In addition to their effect as simple accessories, telegraph poles may be put to practical use in leading electrical wires that connect miniature lighting installations with the power supply, or any other circuits that may be necessary in the general plan of the line. The realistic look of the poles is of course considerably enhanced where such wires are used. Alternatively, thread may be placed over the insulators if actual wire is not required, and will contribute a great deal to the air of finish of the line.



A realistic photograph showing a miniature express train arriving at a busy station. This is part of the layout of L. F. Weir of Portsmouth, who is a keen Hornby Railway enthusiast.

SHUNTING OPERATIONS

Shunting is an interesting phase of railway working, and its successful reproduction in miniature adds a great deal to the zest of the train operations usually carried out. The shunting yard layout is generally governed by the space available. Where this is limited, and the usual oval railway is operated from the outside, the centre of the layout may be made to consist almost entirely of sidings. If a line is run off the main track at an angle, and a succession of points are laid in this so that a number of roads parallel to the main line result, quite a useful yard formation is obtained. The incorporation of a spur line to prevent the occupation of the main line by a shunting train is a valuable feature, but cannot always be carried out.

A suitable number of wagons may be distributed on different roads in the yard, and the task of the yard engine or "pilot" is to shunt them so that they make up a complete train in a certain order that has been determined beforehand. Brisk coupling and uncoupling, and of course smart management of the engine, are necessary to obtain the best results. The engine need not be wound fully, only a few turns of the key being necessary to enable it to carry out each particular movement. This will result in the operations being carried out at a realistic pace, and with no fear of derailment or other trouble.

A popular scheme nowadays, following actual practice, is "hump" shunting. A gradient is incorporated, and the engine pushes the wagons up the slope to the crest, from where they run down by gravity and are directed into one or other of the various sidings arranged at the foot of the gradient. To obtain the best results the Hornby die-cast spoked or Mansell Wheels should be fitted to the rolling stock. Careful tests will have to be made to determine the most suitable gradient, as different circumstances will affect this considerably.

Coupling up of the wagons is of course rendered a simple matter with the automatic couplings now standardised. For uncoupling the Hornby Shunter's Pole should be brought into play. Each coupling loop has a small projection that engages with a stop formed on the hook and prevents the loop from being thrown up too far if vigorous shunting is being carried on. If the projection on the loop of the lower of the two couplings engaged is smartly knocked with the Shunter's Pole, both loops will be raised and the couplings will disengage. This should be carried out immediately before the wagon reaches the top of the hump. The engine is then checked and the wagon runs down the slope and into the siding required. Keen observation on the part of the "shunter" is necessary, and he and the "engineman" must become used to working strictly in unison, for practice will make successful operation a certainty. When one operator performs the work the task is somewhat easier, provided that the train is not too long.

CRANE LOCOMOTIVES

Crane locomotives are largely used in industrial operations, and the railway companies also employ them to a certain extent. They have the advantage that they can readily travel with their loads, and they may be employed as ordinary shunting engines when their services as cranes may not be required. The date of their origin appears somewhat doubtful, and one of the earliest examples appears to have been the result of the addition of a crane to a small L.N.W.R. tank engine for use at Crewe Works in 1865. Since then of course notable developments have taken place. The crane may be mounted above the locomotive boiler or behind the cab; and the jib, although capable of slewing, may not have any "derricking" action, which means that the foot of the jib is, as it were, hinged.

As the subject of another of our conversion schemes, of which a number have appeared in the "*M.M.*," a crane locomotive is likely to be of interest. A notable point about the scheme is that the alterations to the locomotive required for this purpose are exactly the same as those carried out for its use as part of a rail motor unit. Thus readers who followed up that plan a month or two ago may care to use the same locomotive for both purposes, so that when the rail motor is not in service the engine may form part of the crane unit.

A Hornby Crane Truck is next required, and possibly one will be to hand that has seen some wear and tear but is still suitable for the purpose in question. Whereas in real practice the engine and crane both have a common frame, it is necessary in miniature to allow some swivelling action to take place between them owing to the sharpness of the curves. Therefore we proceed to remove the buffers and couplings from one end of the crane truck. The next step is to cut away the axle-guards from the solebars, though the latter are left in place on the wagon. The eyelet on which the crane portion pivots is now removed, so that the vehicle is practically taken to pieces.

We now require the bogie that we took off the Metropolitan Coach recently fitted up as part of the rail motor unit. A Meccano Bolt ¾" long is passed through the bottom of the crane structure, the floor of the truck, and then through the centre of the bogie. It should be long enough to allow a washer, a short length of compression spring, another washer and locknuts to be fitted without the bogie becoming too stiff. The actual degree of adjustment is best left to the judgment of the individual enthusiast.

This having been done, we find that the floor level of the locomotive is higher than that of the crane, and thus the pin that we used to articulate the engine and coach of the rail motor can be used again. It is passed through the floor of the engine as before, and two Meccano ¾" Pulleys are put on to fill up the distance between the engine and crane bases. A washer and locknuts beneath the crane base complete the job, and sufficient play should be left to allow for any inequalities there may be in the track.

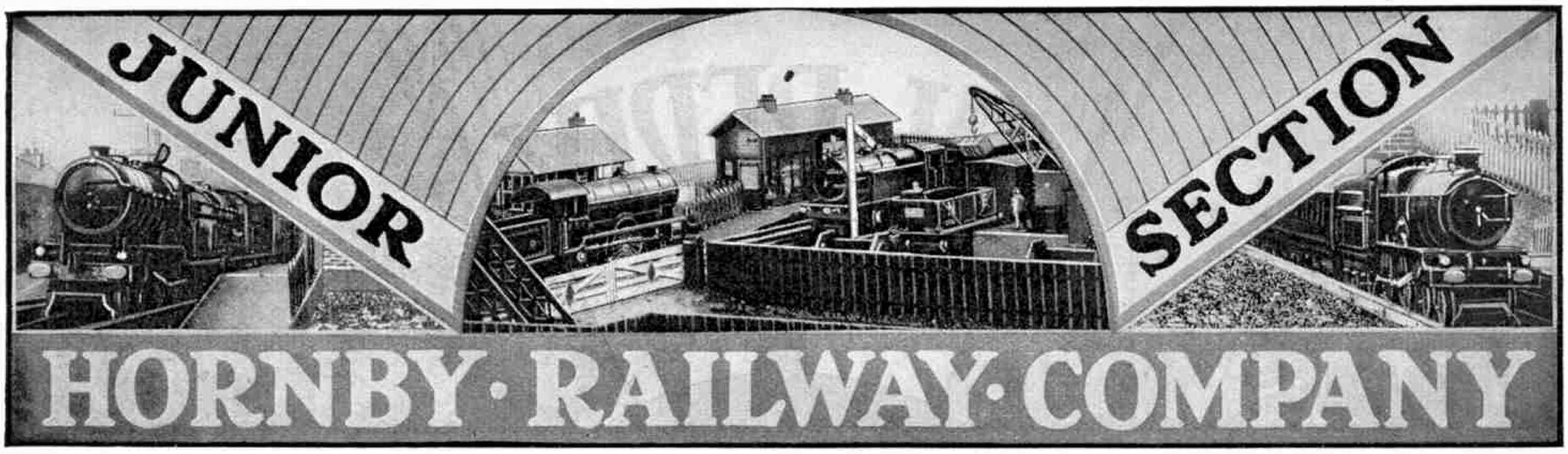
It will be found that the crane jib must travel pointing backward, and cannot be slewed over the engine cab. This, however, is no great objection, and the crane hook can be made to pass through the coupling link at the rear end to prevent it and its weight from swivelling about, and to steady the jib itself.

This completes a handy and novel rolling stock component, which no doubt will be found attractive by numerous Hornby Railway owners. The use of the rail motor locomotive in this manner will be an economical arrangement that will appeal to those who have only one engine available for such duties.

INTERNAL FITTINGS FOR PULLMAN COACHES.—We agree that the internal finish of Pullman and other vehicles would be attractive, but the increase of price necessary to carry out the work satisfactorily would be against any move of this kind. We suggest that you experiment on your own coaches and see what can be done in the matter. Possibly we may be able to include some hints on the subject in this page at some future date. (*Reply to F. Crossley, Warwick.*)

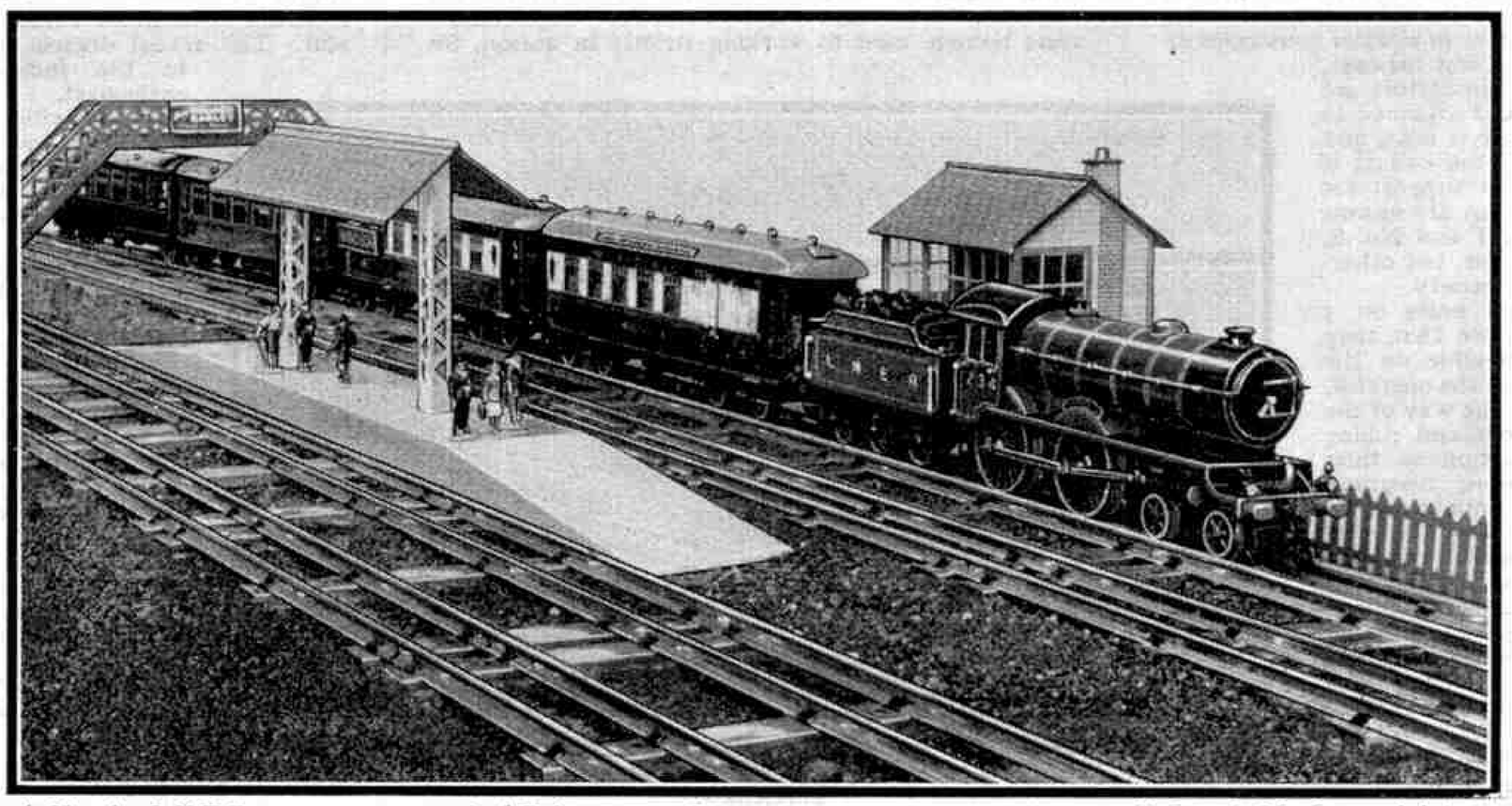
LARGE RADIUS POINTS.—We agree that difficulties occur when it is desired to lead a connection off the outside of curved Double Track. These difficulties may be overcome by using Right-Hand or Left-Hand Points turning off the straight portion of the track, but this is sometimes impossible owing to the restrictions of space, and in any case the reversing of the points lever sleeper is necessary. Points of the pattern you suggest, with a radius corresponding to the outer curve of our DC2 would certainly be useful, and we shall consider the idea. (*Reply to R. S. Williams, Blackpool.*)

ELECTRIC MOTORS FOR No. 2 SPECIAL LOCOMOTIVES.—The popularity of electric traction for model railways increases every year, and we agree that the application of electric motors to the Hornby No. 2 Special Tender Locomotives would be a welcome improvement. You will doubtless be pleased to hear that some of the smaller Hornby engines are now available with motors wound for 20 volts, and are capable of being operated from either accumulators or transformers. We shall consider supplying the No. 2 Specials with electric motors. (*Reply to P. Cowan, Folkestone.*)



XLVI.—EAST ANGLIAN TRAIN SERVICES

MANY readers will remember that rather more than three years ago—in May, 1929, to be precise—we described an elaborate miniature railway layout operated by Mr. M. B. Flanders of Walthamstow. Its interest lay in the fact that it was arranged on a somewhat novel plan, the trains having no motive power, but being propelled by hand. A section of line that is rarely represented in miniature was chosen as the prototype—the Great Eastern section of the L.N.E.R., with its terminus at a miniature Liverpool Street. The chief G.E. type engines compare well with others of similar types on foreign lines, and there are in addition numerous features of distinct interest in the operation of the line, so that it is difficult to understand why so little interest has been taken in the line as a prototype for miniature systems. It has much to recommend it for Hornby layouts, however, and we propose to deal with it as our topic this month.



A Hornby L.N.E.R. express composed of Pullman and Saloon Coaches. Such a make-up will be suitable for a miniature "Hook of Holland" Express, as described in this article.

Readers may object that there are no items of essentially Great Eastern character in the Hornby Series as far as engines, coaches and wagons are concerned. However, this is where the grouping of railways has been such an advantage to model railway owners. L.N.E.R. locomotives of standard classes now work side by side with Stratford productions, and coaching stock of standard design is also to be found on the G.E. Standard Hornby L.N.E.R. locomotives may therefore be used quite correctly, and No. 2 Saloon Coaches equally so; while of course Pullman cars are suitable for almost any line. The Hornby No. 2 Special Pullmans may be used quite as well for the "*Eastern Belle*" of the G.E. section as the "*Queen of Scots Pullman*" of the G.N.

The provision of suitable engines and stock is therefore not so difficult a matter as might be thought at first. Let us consider, for instance, the running of the Harwich Continental Boat Expresses. The engines used in real practice are invariably of the "Sandringham" class, but the family likeness between the two allows us to employ the Hornby "Yorkshire." In making up a miniature "*Hook of Holland*" Boat Express, therefore, a train of No. 2 Saloons in L.N.E.R. colours and one or two Pullmans hauled by a No. 2 Special L.N.E.R. Locomotive will give quite a good effect, and on a suitable layout will be able to imitate the energetic running that is characteristic in real practice of these trains. Of course a Hornby No. 3 Locomotive might be employed if required, and apart from its name and number there is no great objection to its use.

For the famous "*Eastern Belle*"—the all-Pullman de luxe express running between Liverpool Street and the East Anglian coast resorts—the Hornby No. 2 Special vehicles are most appropriate, and make a very smart complete train duly finished off with Pullman Composite Coaches at each end. Although this title is not included among the range of Hornby Train Name Boards, there is no great difficulty in making these from white card provided that the coaches have suitable brackets for the reception of the Boards, or have been fitted with the Clips specially designed to adapt coaches of older type.

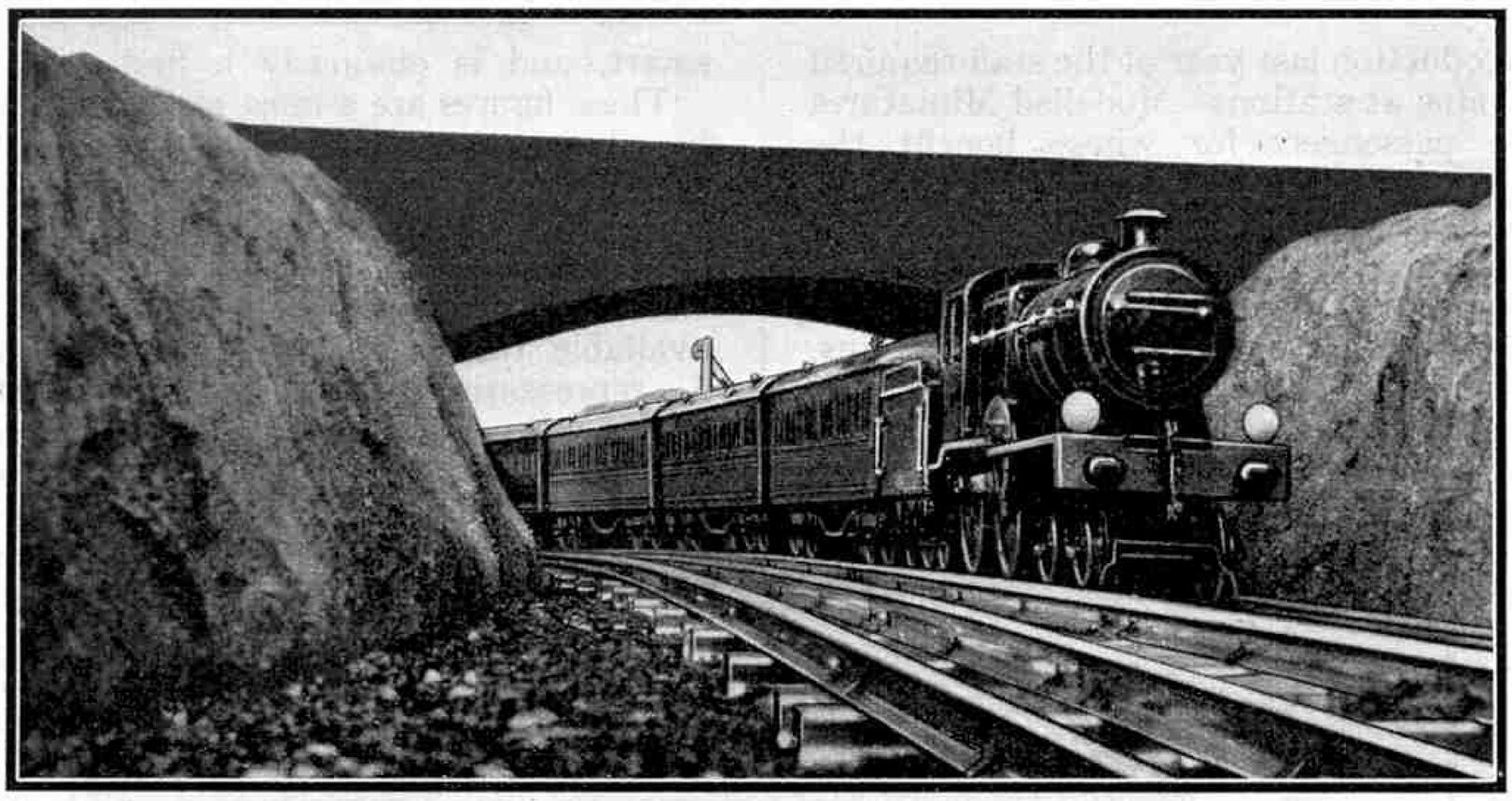
The ordinary express trains may be made up of No. 2 Saloons, and if desired the principle of articulation may be applied to some of them. The method of carrying out this scheme has been previously described in the "*M.M.*," so that there is no need to refer to it in detail here. Readers interested should consult the April issue of this year.

As a line dealing with a vast amount of holiday and

general traffic to East Anglian resorts, the Great Eastern section has to make lavish provision for catering, so that this point should not be missed as far as it concerns miniature railways. The kitchen compartments of the restaurant cars may be imitated by slipping tracing paper between the windows of the Hornby No. 2 Saloon Coaches and the sides. This has the effect of ground or whitened glass, such as is found in kitchen and similar vehicles. There is no need for any adhesive, the paper being held firmly enough in position.

In considering the ordinary expresses and the longer-distance residential trains, L.N.E.R. enthusiasts are very fortunate in that the finish of the Hornby Metropolitan Coaches is extremely close to that of the coaches required for their own line. There is therefore no reason why these Metropolitan vehicles should not be included on a miniature L.N.E.R. system, for they form a useful addition to the coaching stock already available. There is of course the full six-compartment coach, and the other variety with guard's and luggage accommodation at one end, the latter being a very useful composite type of vehicle. Two of these coaches flanking one of the former make up a very suitable unit for general services.

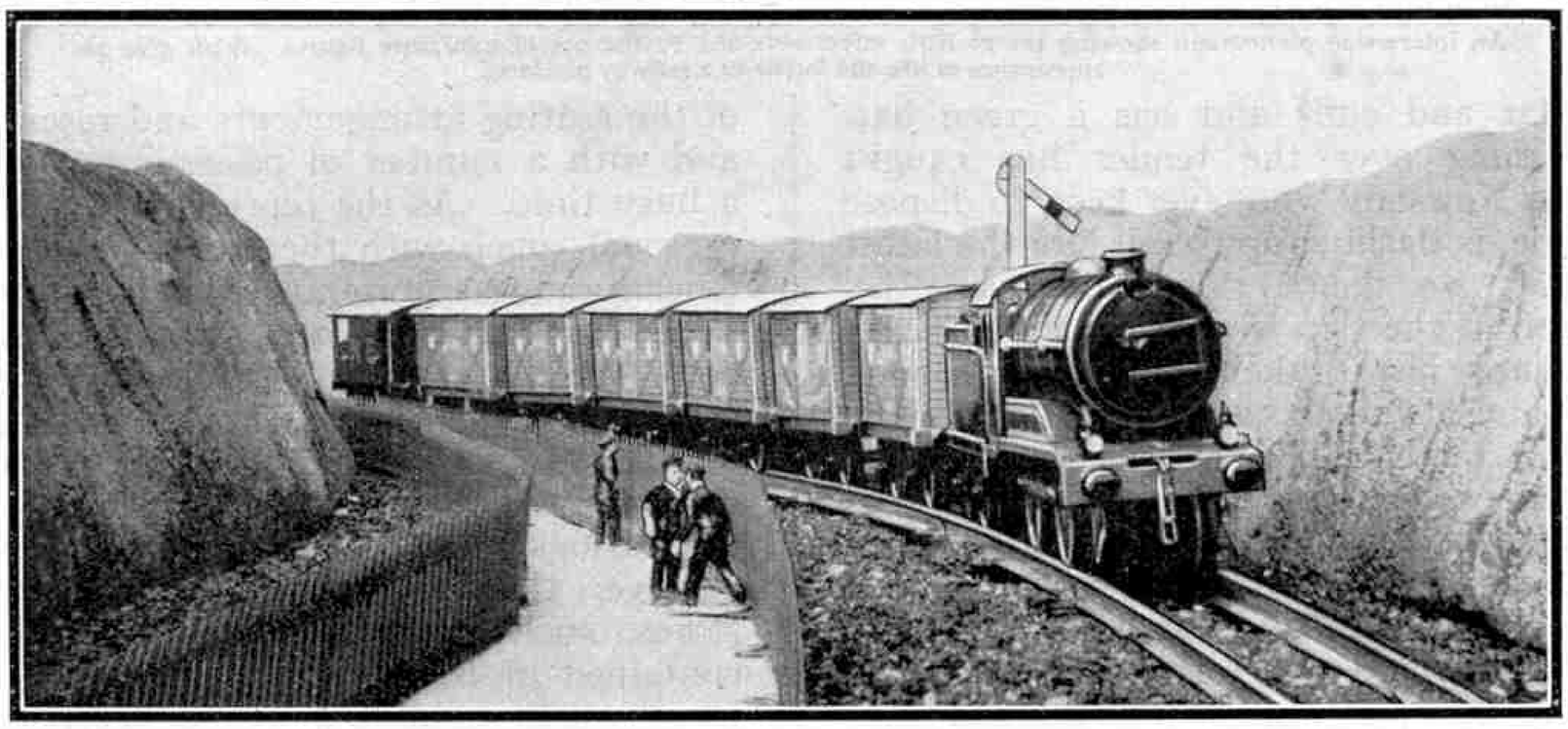
This brings us to an interesting point in connection with suitable locomotive power for ordinary work, in order to reproduce more or less in miniature the well-known Great Eastern "Claud Hamiltons" and the engines of more up-to-date series known as the "Super Clauds." Those who still have the old Hornby No. 2 Locomotives have every reason for maintaining them in service to represent such engines. Those requiring a more up-to-date engine, yet still necessarily of the inside cylinder 4–4–0 design that is so typically British, may care to take advantage of the scheme adopted by one of our readers. A certain general similarity will be noticed between the "Super Clauds" and the Hornby No. 2 Special S.R., more particularly in the Belpaire fire-box, side-window cab and extended smoke-box. This suggested the use of one of these Hornby 4–4–0s, which was repainted to match an L.N.E.R. No. 2 Special Tender, which is very similar in general contour to a G.E. type. As a final touch the chimney top was picked out in gold to represent the smart brass cap still found on many G.E. engines. The result of this unexpected pairing of engine and tender is quite pleasing, and no doubt many G.E. section enthusiasts will seriously consider the idea.



This photograph shows the use in miniature of discs instead of lamps as practised on the G.E. section of the L.N.E.R. They may be cut from white card and attached to the engines by means of suitable loops.

We now come to a feature that is very characteristic of the G.E., and which accounts for the extraordinary degree of activity in Liverpool Street Station itself and in the immediate suburban area. What is probably the most intensive steam-worked service in the world is operated in and out of that terminus daily by an army of tank locomotives. This then is a great opportunity for making use of set trains of Hornby No. 1 L.N.E.R. Coaches, possibly close-coupled as suggested recently, or of trains composed on a more ambitious scale of Metropolitan bogie vehicles. For lighter trains the M3 and No. 1 Tanks may represent the numerous tank engines of diminutive design formerly belonging to the G.E. These are now largely displaced by bigger engines, such as the G.E. type 0–6–2s, and their later group developments, well known as the "N7s." The No. 1 Special and No. 2 Special Tanks may be employed with every justification to take the place of the latter classes. For such intensive services the loads dealt with by each engine require careful consideration to obtain the best results, and the layout of stations and track must be carried out with care, so that run-round roads, water tanks and coal stages, if provided at the engine sidings, are all situated with a view to the expeditious running of the services that have been planned.

(*Continued on page 770*)



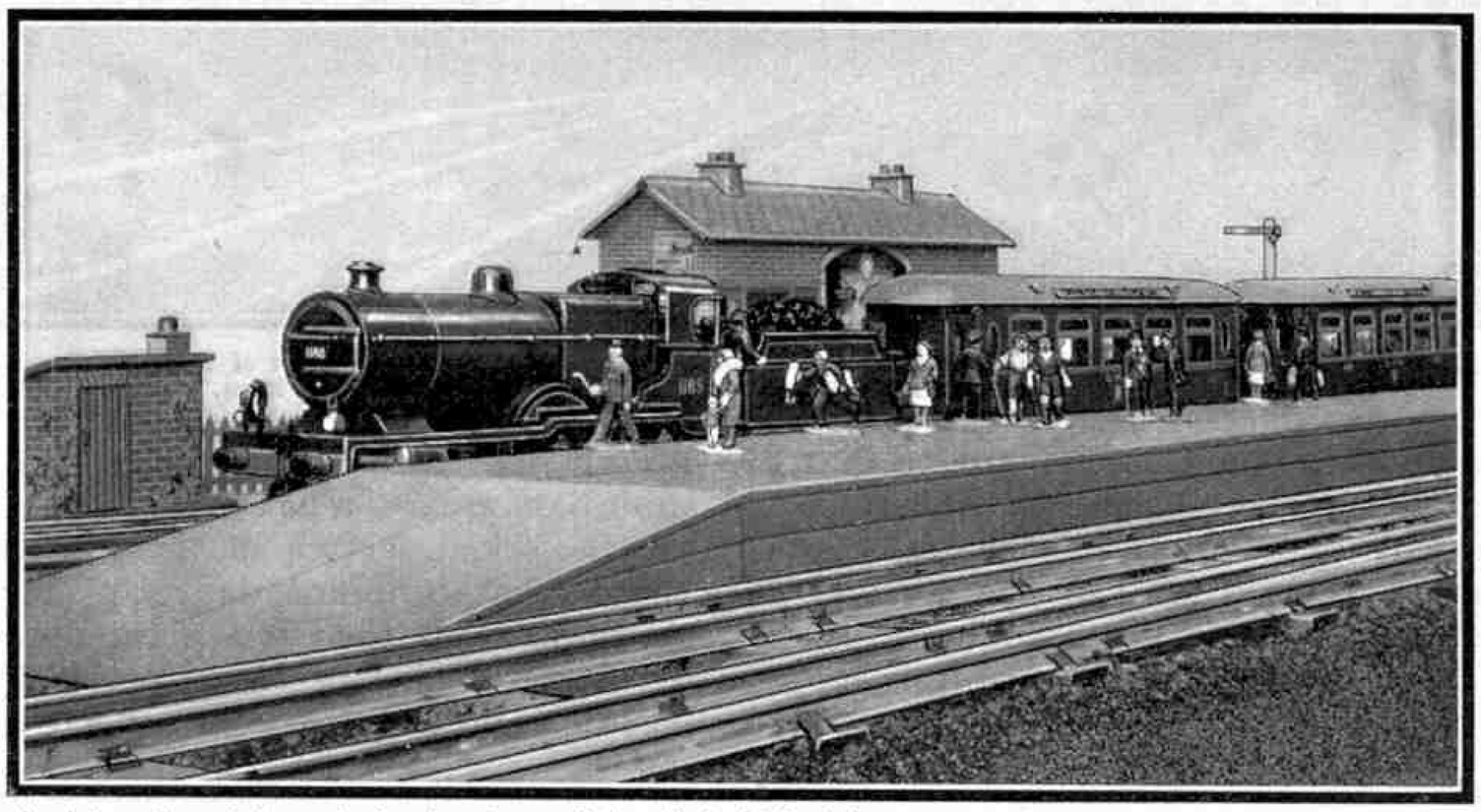
A fish train on a single line branch. This represents very well the numerous trains operated from Yarmouth and Lowestoft during the herring season.

More Miniature Railway Figures

By "Tommy Dodd"

AFTER the introduction last year of the staff required to handle trains at stations—Modelled Miniatures No. 1—the passengers for whose benefit the trains are run have now made their appearance in Set No. 3 of the same Series. I am sure that these figures will be greatly appreciated by Hornby Train owners, who will hasten to add them to their railway equipment and so provide a reason for the running of the trains. The accompanying illustration gives a good idea of the various figures, and we will therefore consider them in the order in which they appear, from left to right in the picture.

First we have the Lady and Child. The Child is evidently interested in the locomotive and driver, and is possibly a future railway enthusiast, although at the moment a teddy bear is tightly clutched under one arm. The Lady is smartly dressed in a green coat with fur collar and cuffs and has a green hat.



An interesting photograph showing the realistic effect obtained by the use of miniature figures, which give an appearance of life and bustle to a railway platform.

The fireman leaning over the tender has caught the attention of the Newsboy who, ever keen to dispose of his stock-in-trade, is dashing up to sell him the latest "sporting edition." No doubt this will engage his attention at the end of the trip when the tender locker is opened and the dinner box is taken out. The Newsboy has a brown suit and a very rakish-looking cap. His haste is well shown by his attitude, the moulding of the figure being very well carried out.

An attractive figure is the Girl who is standing by the rear of the tender. She is evidently going out for the day, with her mackintosh over her left arm and a small case in her right hand. Her twin sister may be seen further down the platform being ushered into the train by an attentive porter.

Stepping from the first door of the train are two Hikers, typical representations in miniature of the modern open air enthusiasts. They have evidently completed the first part of their journey by train, and no doubt will cover many miles on foot before the end of the day. Both are dressed in regular hiking kit. They have stout sticks, and their rucksacks are carried on their backs in the orthodox manner.

Finally there is the important-looking Gentleman who is talking to the stationmaster. He wears a blue suit of the latest cut and the usual bowler hat, and has the appearance of being a successful man of business. With his cane, spats and gloves he looks decidedly smart, and is obviously a first-class passenger!

These figures are a most attractive collection, and can be strongly recommended to all Hornby Railway enthusiasts to give an appearance of life and bustle to railway platforms.

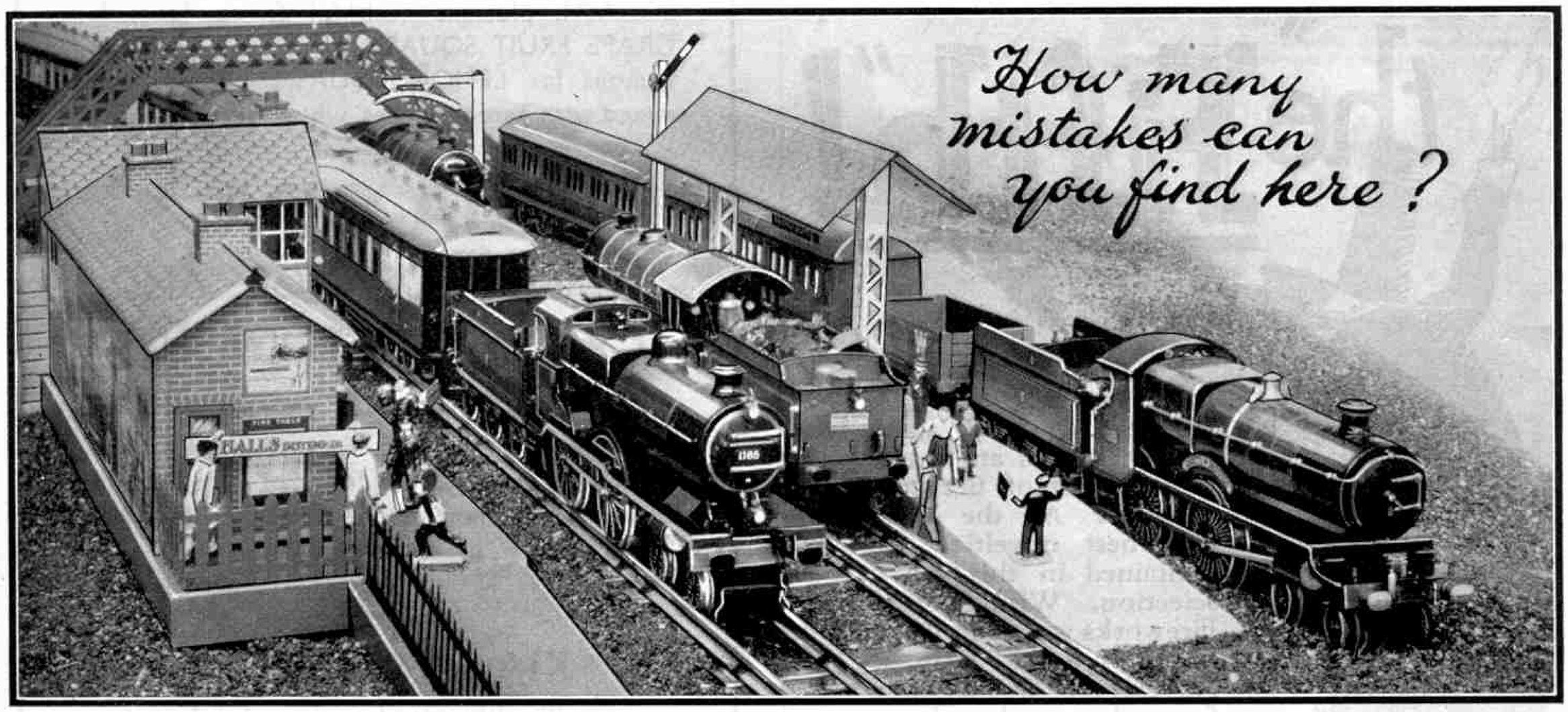
In addition to the miniature railwaymen of Set No. 1 that I dealt with some time ago, there are now available the figures in Modelled Miniatures Set No. 5, representing Train and Hotel Staff. There are five figures in this set, three of them representing Pullman and Restaurant Car Attendants, the other two being Hotel Porters. The Chief Car Attendant has a white coat as usually worn by stewards and travelling attendants, and blue uniform trousers. He should be in evidence on the platform near the Pullman or Saloon Coach before the departure of the train, for he is in charge of the seating arrangements and reservations for meals, and with a number of passengers to deal with he has a busy time. As the representative of the company in personal touch with the passengers he is a responsible official and has quite an important appearance.

His subordinates are similarly dressed, but they have shorter coats and different caps, showing their inferior rank. The shorter coats are more suitable for their duties, for they have to pass up and down the narrow gangway through the train in attending to the various wants of the passengers. On the platform, however, they can be quite usefully employed handling stores, such as may be represented by the hamper contained in Railway Accessories No. 1, or they may be shown in suitable positions near the train.

The Hotel Porters are in different liveries and are quite novel and attractive. They may be used independently, or in attendance on one or other of the miniature passengers, who may have come from a local hotel to board the train, or may be on their way to the hotel. They are distinctly interesting figures and help to give a distinguished air to the platform of any station they may be used upon. They remind us of the familiar announcement that "Hotel porters meet all trains." Naturally it is more usual for them to appear on the platforms of big terminal or junction stations, but in certain cases where important trains may stop at wayside stations for holiday and tourist traffic, their use here also will be quite in order.

H.R.C. COMPETITION PAGE

Competitions appearing on this page are open only to members of the Hornby Railway Company. Envelopes containing entries, should have the title of the competition clearly written in the top left-hand corner, and should be addressed to the Hornby Railway Company, Binns Road, Old Swan, Liverpool. The name, address and membership number of each competitor should appear in clear writing on every sheet of paper used.



Errors Contest No. 3

The "Errors" Contests announced in the *"M.M."* of September, 1930, and June, 1931, brought an exceedingly heavy crop of entries, and clearly showed that this type of competition is one of the most popular that appear on this page. This month we provide H.R.C. members with another Contest of the same type.

The accompanying illustration shows a typical station scene in which many mistakes of various kinds have been introduced, and competitors are required to point out as many of these mistakes as they can find. Even at a casual glance several errors are obvious, but competitors must not make the mistake of thinking that they can discover them all in a few minutes. Some of them are carefully concealed and can only be found after careful study.

When a competitor has found as many errors as possible he must make out a neat copy of his list and forward it to H.R.C. Headquarters, Binns Road, Old Swan, Liverpool, in an envelope clearly marked "*H.R.C. Errors Contest No. 3.*"

The descriptions of the mistakes that are found should be made as brief as possible.

The Contest will be divided as usual into two sections—Home and Overseas. Prizes consisting of Hornby Train goods (or Meccano products if preferred) to the value of 21/–, 15/–, 10/6 and 5/– respectively will be awarded to the senders in each section whose lists contain the largest number of genuine mistakes. A number of consolation prizes will also be awarded.

In the event of a tie neatness and originality in presentation will be the deciding factors in awarding the prizes.

Each competitor must give his H.R.C. membership number, and entries must be posted to reach Headquarters on or before 31st October. The closing date for the Overseas competitors is 31st January, 1933.

Layout Planning Contest

By this time almost all model railway enthusiasts will have again brought their railways into operation after a more or less complete rest during the summer months. In almost every case some change in layout will be contemplated to add additional realism to the working of the railway. We are greatly interested in the ideas of H.R.C. members in regard to layouts, and this month we offer prizes for a special Layout Planning Contest.

For this Contest competitors must submit a design of a layout incorporating two terminal stations, one of which must include "run-round" loops and direct access to an engine shed and a turntable. The arrangement of the other terminal station and of the line generally is left to the competitor's own judgment. It should be remembered that layouts will be judged in regard to their possibilities for railwaylike operations, and not according to the amount of material that is employed.

The Contest will be divided into two sections—Home and Overseas. Prizes consisting of Hornby Train goods (or Meccano products if preferred) to the value of 21/–, 15/–, 10/6 and 5/– respectively will be awarded to the senders in each section of the four best entries. A number of consolation prizes will also be awarded. In the case of a tie for any prize, neatness will be one of the deciding factors.

Envelopes containing entries should be clearly marked "*H.R.C. Layout Planning Contest*" and posted to reach Meccano Ltd., Binns Road, Old Swan, Liverpool, by 31st October. Overseas closing date, 31st January, 1933.

COMPETITION RESULTS

HOME

July "Impossible Train Contest No. 3."—First: G. F. Huskisson (29448), Buckhurst Hill. Second: W. B. Hudson (1733), Weymouth. Third: D. C. H. Stamford (17558), Merstham. Fourth: D. M. Herbert (24995), Manchester. Consolation Prizes.—E. R. Levitt (27335), London, S.E.3; J. Hill (7111), Portchester, Hants.; L. L. Luck (1685), Portsmouth; R. Burrell (27679), London, S.W.16; E. H. Frewin (25098), Birmingham.

July "Summer Photo Contest No. 2."—First: R. C. T. Lyle (30157), Hereford. Second: S. Garbutt (30122), Altrincham. Third: W. N. Phillips (14727), Birmingham. Fourth: J. W. Hague (1258), Ripon.

OVERSEAS

April "Favourite Locomotive" Contest.—First: R. Wragg (7913), India. Second: A. McMillan (28869), Canada. Third: P. Meiring (24725), S. Africa. Fourth: V. Cornforth (29218), New Zealand.

April "Cab Drawing" Contest.—First: S. D. Kurlawala (28724), India. Second: K. Wright (15224), New Zealand. Third: D. Adams (17401), Australia. Fourth: H. J. Borgman (29579), Holland.

First for the "Fifth"!

We lead the way again this year with an unsurpassed feast of firework delights! All the latest and best novelties are contained in this year's selection. With Brock's Fireworks you cannot fail to have a good "Fifth of November." So buy your fireworks at the shops which sell **BROCK'S "CRYSTAL PALACE" FIREWORKS.**

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Harlequins	1d. 2d. etc.		
Egyptian Palms	1d. 2d. etc.		

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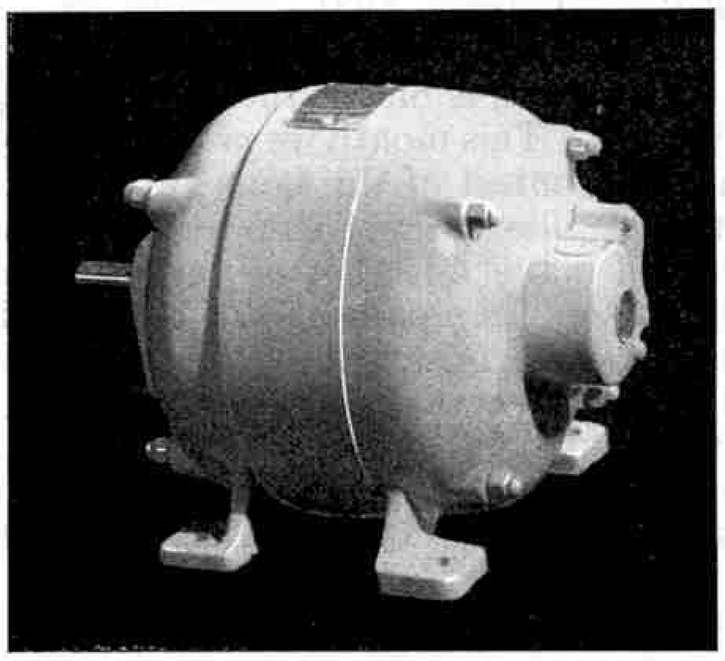

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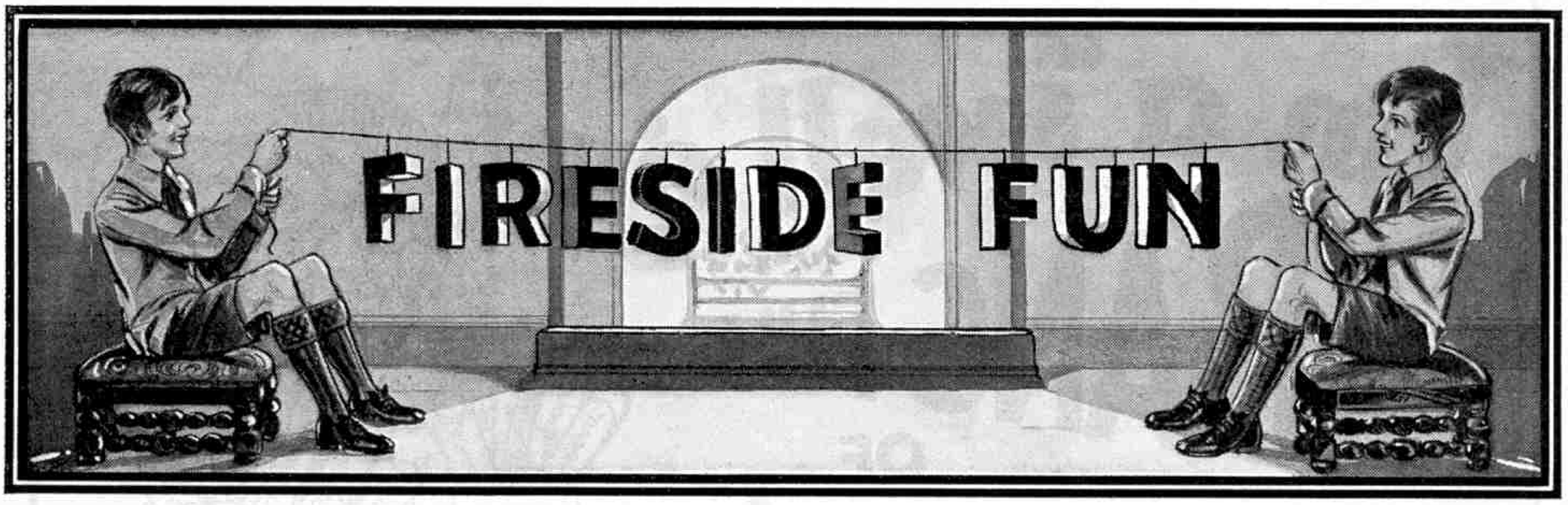


RISING STEADILY

Schoolboy: "Well, Mother, I have better news this time."

Mother: "Then you must have passed at last. I'm so glad."

Schoolboy: "Well, I didn't exactly pass—but I'm top of those that failed."

* * * *

"Sambo, what's the matter with your dog? He seems to be in pain."

"Nossuh, he ain't in no pain—he's jes' lazy, dat's all."

"But surely he must be suffering or he wouldn't howl like that?"

"Jes' plumb laziness, sah, jes' laziness—ya see, sah, he's sitting on a thistle."

* * * *

"Have pity, sir!" whined the beggar, "It's sad to be old and bent."

"I suppose it is," replied the callous young man; "but I can tell you that it's almost as bad to be young and broke."

* * * *

"What would happen if this lift should drop to the bottom?" asked the nervous passenger as they drew near the top of the skyscraper.

"Gosh," exclaimed the lift girl, turning pale at the very idea, "I'd lose my job!"

* * * *

An Army officer had just asked the recruits if they had any complaints. After a short time one stepped forward and declared he had been supplied with a ginger-ale bottle that contained not ginger-ale, but benzine, and that he had drunk half the benzine before he realised the mistake that had been made.

The officer was very perturbed.

"That's too bad," he said, "You had better not smoke for a few days!"

* * * *

"I'm just going out to buy a book."

"A book—why?"

"It was my birthday yesterday, and had such a wonderful reading lamp given me!"

* * * *

"Do you enjoy good health?" the reporter asked the oldest inhabitant.

"Course I do," said the old man. "Who doesn't?"

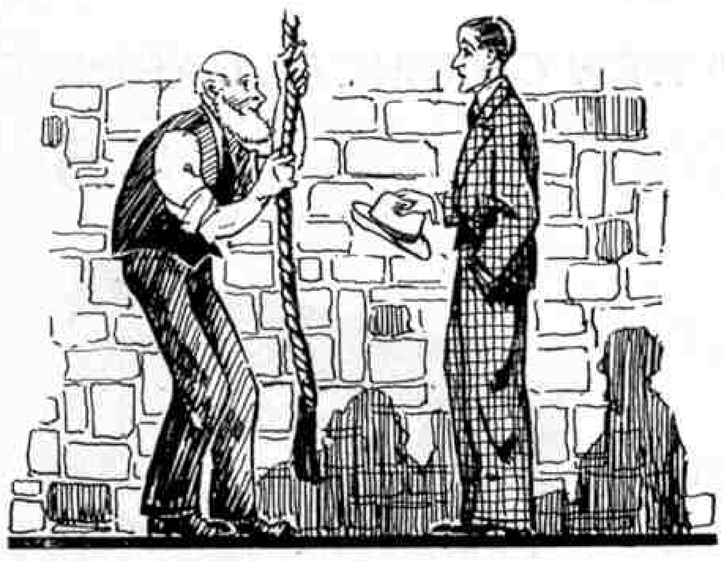
* * * *

Foreman (testing wall of new house): "Hi, Bill! Can you hear me?"

Bill: "'Ear yer? I can *see* yer in three places."

* * * *

SOUND REASONING



The tourist had been inspecting a little country church.

"Why is the bell ringing, my man?" he asked the verger, as he was stepping out into the open again.

"'Cos I'm pulling the rope," came the reply.

* * * *

The young man was trying to impress his companion.

"Yes," he said, "I'm a very efficient thought reader. I can tell what a person is thinking."

"In that case," said the other, "I beg your pardon."

QUICK SERVICE

Waiter: "Your coffee, sir. It's special from South America, sir."

Diner: "Oh, really! That's where you've been all this time, is it?"

* * * *

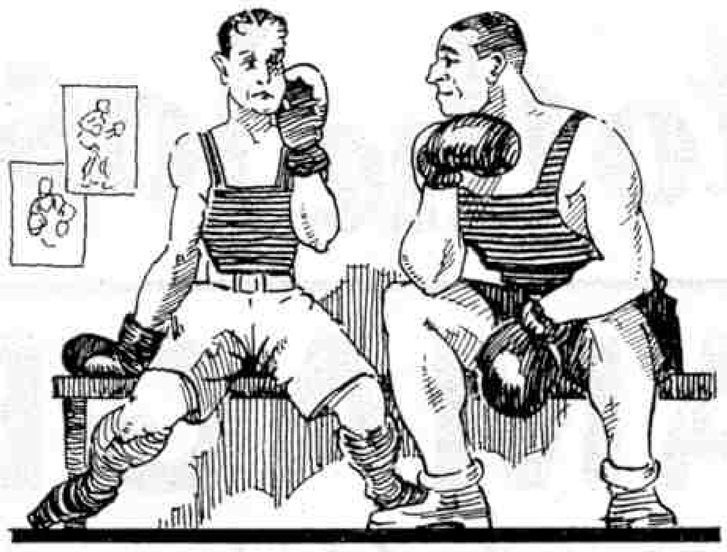
"I have just the horse for you," said a horse dealer to a farmer. "He's sound as a bell and goes ten miles without stopping."

The farmer shook his head.

"Not for me," he said, "I live eight miles from town and with that horse I should have to walk back two miles!"

* * * *

POSTMAN'S KNOCKS PREFERRED



Teacher at School of Boxing (to newcomer): "Now you have completed your first lesson, is there any question you would like to ask?"

Newcomer (rubbing his bruises): "Yes, there is. Can I finish the course by correspondence?"

* * * *

Isaacstein (boastingly): "Wherever you go in the world, you will always find we Jews are the leading people."

MacDoodle (sarcastically): "Nonsense, mon, hoo about the North Pole?"

Isaacstein: "Vell, Iceberg ain't no Scotch name, is it?"

* * * *

The young society man was boasting of his family tree.

"And I, madam," he said proudly, "am the last of the Smythe de Smythe-Veres."

"I'm very pleased to hear it," said his bored listener."

* * * *

Customer (indignantly): "What does this mean? There's a fly in the bottom of my teacup?"

Waitress: "How should I know? I'm a waitress, not a fortune-teller."

* * * *

"You have been a very naughty boy, so as a punishment I'm going to send you to bed without any supper."

"But what about the medicine I have to take after meals?"

* * * *

A young man at the theatre was annoyed with the constant coughing of the man sitting next to him.

"That's a bad cough of yours," he ventured during the interval.

"I'm afraid it's the best I've got," was the reply.

* * * *

"Can I see the gentleman who was brought in here a few moments ago after a motor accident?"

"Well, sir," replied the maid, "he is still very dazed. Are you a doctor?"

"No, I want to sell him another car."

* * * *

"Can you tell me what eats oats, lives in a manger and can see equally well at both ends?"

"No."

"A blind horse."

PERPETUAL MOTION?

Pat, the Irishman, was buying a clock.

"This," said the persuasive assistant, "is an eight-day clock."

Pat scratched his head in wonderment. "What be an eight-day clock, mister?" he asked.

"One that will go for eight days without winding," explained the assistant.

"Begorrah," smiled the Irishman, "how long would it go if you wound it?"

* * * *

"Are you teaching baby to talk yet?"

"Teaching him to talk? We're teaching him to keep quiet now."

* * * *

Small Boy: "I say, Dad, what would Father Neptune say if all the seas were to dry up?"

Father: "I'm sure I don't know. What would he say?"

Small Boy: "I haven't a notion."

* * * *

For some time complaints had been received that William was not working very hard at school. At last his father spoke to him about the matter and, hoping to cure him of laziness, promised him a pound note at the end of each term if his report showed that he was really working.

At the end of the first term after the compact had been made, the report said "Trying," and the boy secured his pound. The next report said "Still trying," and once more the father paid. At the end of the third term, nowever, the true facts of the case were made clear, for the report was "Still more trying."

* * * *

Sergeant: "Did you shave this morning, Jones?"

Recruit: "Yes, sergeant."

Sergeant: "Oh, did you? Well, next time you shave, stand a bit closer to your razor."

* * * *

A little boy came home from school one day with tears in his eyes.

"What are you crying for?" asked his Mother.

"Teacher caned me for not knowing where the Pyrenees are."

"Quite right," said the Mother, "that should teach you to remember where you leave your things."

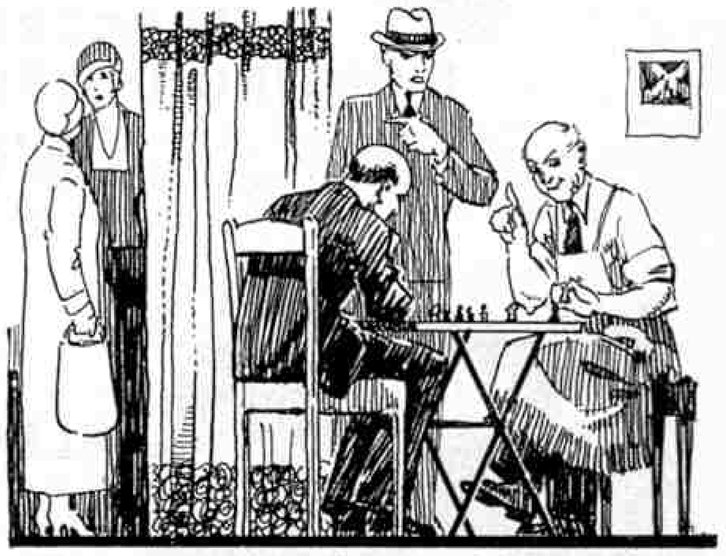
* * * *

"What we need in this country are men with convictions," said the heated orator, "and now, I ask you my friends, where shall we find them?"

"In jail," shouted a voice from the balcony.

* * * *

SERIOUS BUSINESS



The commercial traveller entered the general store in a small country town. Going through to the parlour at the back, as was his usual custom, he came upon the proprietor and a friend engaged in a game of chess.

"Mr. Wood," he said, "there are two customers in the shop."

Mr. Wood did not raise his eyes from the board. After a while he moved a pawn, nodded, and then whispered: "That's all right. Keep quiet and they'll go away again."

I'm a "swell guy"

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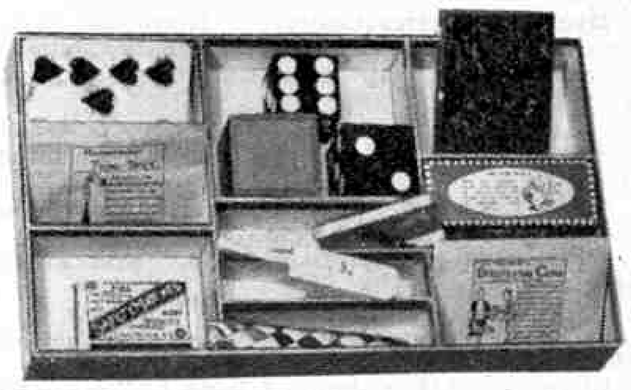

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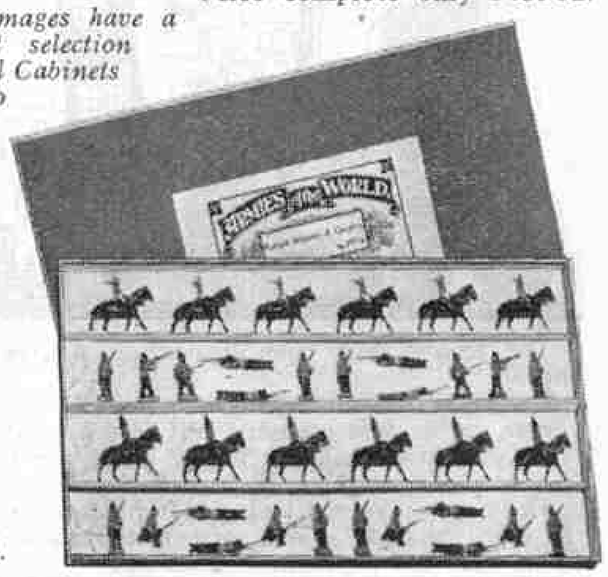
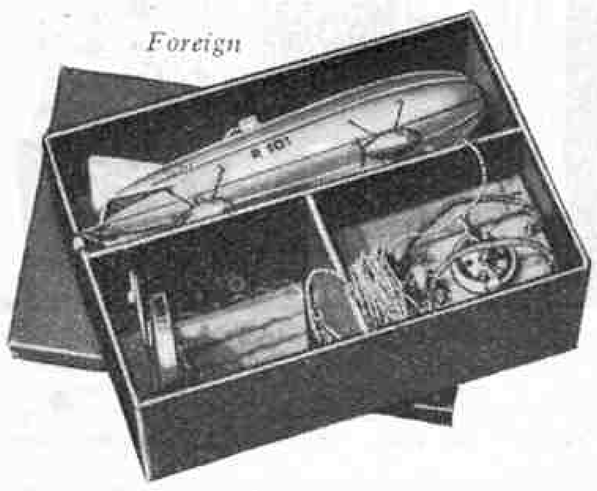


Foreign



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Competition Page

DOUBLET WORD PUZZLE

"Doublets" Competitions have always enjoyed a high degree of popularity among our readers, and in re-introducing them we have no doubt that they will be welcomed very warmly by the majority of readers. They are a fascinating test of nimble-mindedness.

For the benefit of new readers we may recall that the Doublet Word Puzzle was invented by Lewis Carroll, the author of "*Alice in Wonderland*." Lewis Carroll had a very large circle of friends, several of whom complained that the day's social round was not sufficient to occupy their minds, and that time hung heavily on their hands. In order to relieve their tedium, Carroll invented this word game, and his friends received it with so much enthusiasm that after a while he was persuaded to introduce it to the public. It "caught on" immediately, and became quite a rage.

The rules governing the solution of the puzzle are very simple. Two words, each containing the same number of letters, are given, and are termed the Doublet. The puzzle is to change the first word into the second by placing connecting words between the two, each new word differing from its predecessor by the alteration of one letter only, and without any shuffling of the letters. These connecting words are called "links," and the change from one word to the other should be effected with the smallest possible number of links. It is obvious, of course, that only words of exactly the same length as those comprising the Doublet may be used.

As an illustration we give the following examples:

Change COLD to HEAT
COLD—hold—held—head—HEAT
Fit HOOK to BOLT
HOOK—book—boot—BOLT

Competitors should note that in making the links only words appearing in a standard dictionary may be employed. Proper nouns, names of persons, places, etc.—are not permitted.

The Doublets that are to be solved are as follows:—

Select	Book	to	Read
Carve	Meat	to	Bone
Take	Walk	along	Path
Hoist	Sail	with	Rope
Convert	Arch	to	Door
Transform	Curl	to	Wave
Make	Paper	from	Cloth
Place	Stamp	on	Label
Define	Atom	as	Iota
Place	Bird	in	Nest
Run	Race	against	Time
Head	Ball	into	Goal

In judging the entries, the twelve doublets will be considered as one contest, and prizes of Meccano or Hornby Train goods to the value of 21/–, 15/–, 10/6 and 5/– respectively will be awarded to the senders of the four solutions showing the lowest totals of links used throughout the contest. In addition there will be a number of consolation prizes for the entries next in order of merit. In the event of a tie for any of the prizes, preference will be given to the entry having the neatest or most novel presentation.

It will be observed that the combination of the 12 doublets for judging purposes will ensure that a brilliant solution of one doublet will carry its full weight by offsetting, partially, at least, failure to secure the shortest chain in another case.

Entries should be addressed to "Doublets, Meccano Magazine, Binns Road, Old Swan, Liverpool," and sent to reach this office not later than 31st October. There will be a duplicate set of prizes reserved for entries from Overseas readers, whose entries must reach us not later than 31st January, 1933.

Entries must be written on one side of the paper only and each sheet of paper used must bear the competitor's name and address.

This charming bird photograph, entitled "The Tit-Bit," secured first prize in the B section of the April Photo Contest for G. D. Wraith, Bournemouth.

My Favourite Drawing

Some little time ago a reader of the "*M.M.*" criticised the "*M.M.*" drawing contests because "they always take engineering topics for their subjects." Our reader went on to say that although he is keenly interested in engineering matters, his efforts at drawing locomotives and aeroplanes are not half so successful as his efforts in the animal world.

The "*M.M.*" competitions are noted for their fairness, because we have always made a point of endeavouring to give every reader a chance to compete on level terms with his fellow readers. This month, therefore, as an experiment, our drawing contest has no set subject. Competitors may submit drawings of any subjects they prefer, and the prizes will be awarded to the best drawings received, irrespective of their subjects.

The entries will be divided into two sections as usual, A for those from readers aged 16 and over, B for those from readers under 16, and prizes of Meccano products or drawing materials, to be chosen by the winners, to the value of 21/– and 10/6 respectively, will be awarded to the best and second-best entry in each section. In addition there will be a number of consolation prizes.

Entries should be addressed "My Favourite Drawing, Meccano Magazine, Binns Road, Old Swan, Liverpool," and must reach this office not later than 31st October.

A duplicate set of prizes is offered for competition among Overseas readers, in precisely similar age groupings. Entries from Overseas readers must arrive not later than 31st January, 1933.

COMPETITION RESULTS

HOME

July Photo Contest.—First Prizes: Section A, A. B. Bishop (Bristol); Section B, P. H. Race (Lincoln). Second Prizes: Section A, Jt., M. Roche (Mallow), D. E. Cooper (Witham); Section B, D. V. James (Norwich). Consolation Prizes: D. Coombes (Dalkey); R. G. Dixon (Berkhamsted); G. Ford (Bognor Regis); T. Ryan (Cahirciveen); L. Sansom (Streatham, S.W.16); J. Wallace (Stevenston).

August Crossword Puzzle.—1. S. C. Thomas (Liverpool); 2. G. Burgess (North Finchley, N.12); 3. C. W. Ralph (Birmingham); 4. G. H. Gurney (Goodmayes). Consolation Prizes: D. Barrett (London, S.E.17); Miss B. Bedford (Birmingham); J. Cole-Samuel (West Norwood, S.E.27); W. F. L. Clement (Willington); F. Crouch (Worthing); D. H. J. Ellis (Blundellsands); K. G. Goodacre (Parkstone); F. Heslop (Doncaster); I. B. Mason (Brighton); A. R. Molyneux (Wallasey); W. J. S. Sellers (Liverpool); F. Spiegelhalter (Barnstaple).

OVERSEAS

Hats Contest.—1. S. D. Kurlawala (Bombay); 2. R. M. Holmes (Capetown); 3. J. R. Johnston (Toronto); 4. S. Perry (Paris).

THE FIRST 500!

To the first 500 readers of the "*M.M.*" who send us 8d. and ask to see our Approval Sheets we shall send a BRILLIANT PACKET OF 41 MINT NEW ISSUES.

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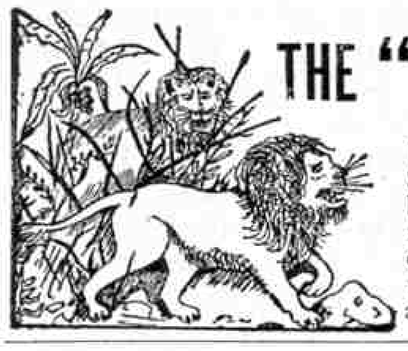

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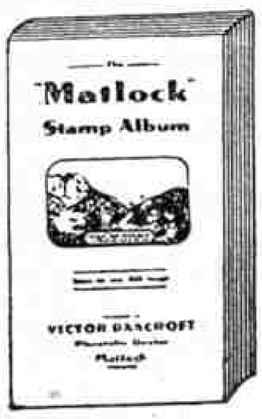

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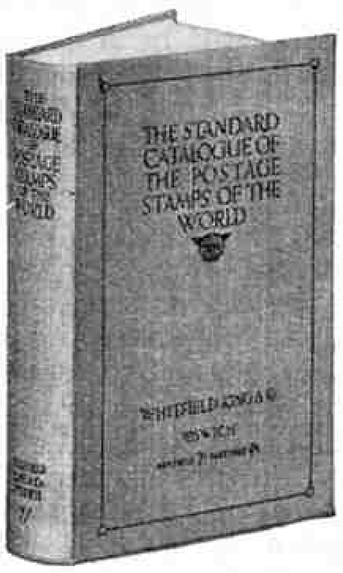

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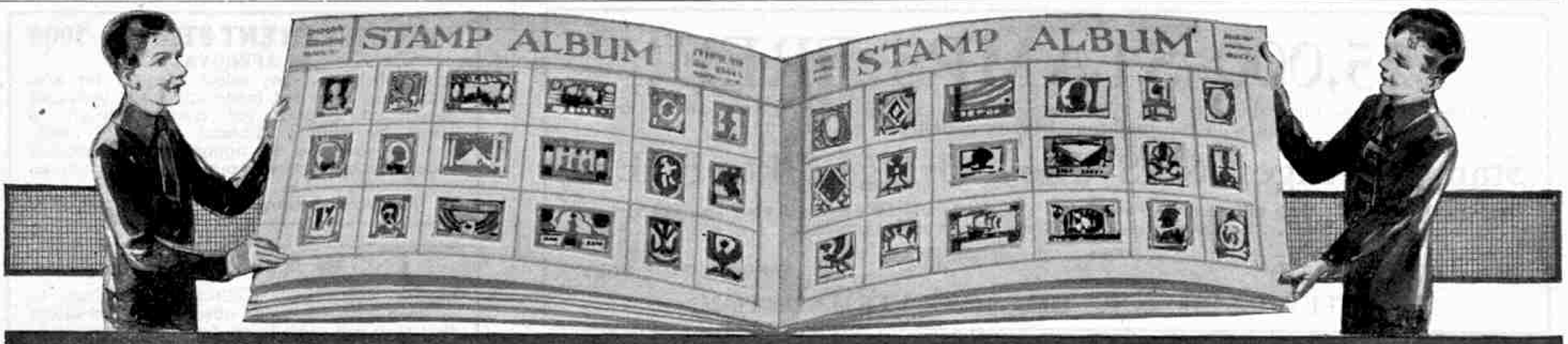

STAMP COLLECTING

THE WONDERS OF ANCIENT EGYPT

FEW of our readers will ever have the opportunity of visiting Egypt to see for themselves the ancient wonders of the Pharaohs, and probably fewer still have the inclination to dig deeply into the science of Egyptology. Ancient Egypt provides much that is fascinating to everyone, however, and the stamp collector is particularly fortunate in that to familiarise himself with the greatest of Egypt's relics he need go no further than his stamp album.

For a period of nearly 50 years, from 1867 until 1914, Egyptian stamp designers remained loyal to a composite picture showing the Great Pyramid of Cheops at Gizeh, the first wonder of the world, and the only slightly less remarkable Sphinx. When, in 1914, a change was made, it was only to extend the philatelic display of the country's treasures, six of the eight stamps in the new series being devoted to the architecture and life of early Egypt.

The exceptions were the 1 millieme value showing native barges on the Nile, a feature of river life at Cairo that has altered little in many hundreds of years; and the 200 m. depicting the Assouan Dam, then the most recent of Egyptian engineering wonders. The Assouan Dam hardly enters the scope of this article, but a few details concerning it may be worth mention. Its construction was the first stage in a great scheme to irrigate the Egyptian deserts, and its completion in 1908, at a cost of £3,000,000, brought several hundred thousands of acres under cultivation, and increased the Egyptian revenue by several million pounds annually. The dam is 2,691 ft. in length, and comprises 111 sluices each 16½ ft. in width.

The 2m. stamp of this series is used to illustrate an image of Cleopatra, deified as Isis, the daughter of the Sun. She is shown crowned with the bull's horns, the sun and the double feather, signifying her sovereignty over Lower and Upper Egypt. The 5 paras stamp of the 1867 series, by the way, provides a further link with Cleopatra. The side framings of this stamp show two obelisks, built about 1150 B.C. in the reign of Thothmes III. These obelisks, commonly known as Cleopatra's Needles, were 70 ft. in length and built of red granite. They formerly stood before the Temple of the Sun at Heliopolis near Cairo, but were brought to Alexandria by the Roman Emperor Augustus and placed before the Temple of Cæsar. In later years they were cast upon the seashore at Alexandria and lay neglected until 1877, when one was brought to England and re-erected on the Thames Embankment.

The third stamp of the 1914 series is the 3m. showing the beautiful old Ras-el-Tin Palace standing on the edge of the harbour at Alexandria. The palace was built in the early 19th century by Mahomet Ali, who reigned from 1805 until 1847. His administration was one of the greatest in the country's history. He not only created a standing army, and established just laws for the collection of the revenue, but also built several colleges and founded the first hospital in Egypt. His work for the medical sciences was commemorated on Egypt's Medical Congress issue of 1928, when his portrait was used for the design of the 10m. stamp. The Mosque in the background of the 50m. stamp of the 1914 series, showing principally the Citadel at Cairo, built in 1176 A.D. by the great warrior Saladin, is Mahomet Ali's mausoleum.

The three Pyramids at Gizeh are the subject of the 4m. design. The largest of the three is the biggest building in the world. It was the outcome of a whim of the tyrannical King Cheops, who reigned over Egypt in 3700 B.C., and conceived it as a tomb in which he and all his property might remain undisturbed after his death.

Originally this great pyramid was 480 ft. in height—about 150 ft. higher than St. Paul's Cathedral in London—and had a base 768 ft. square, with a total ground area of more than 13 acres. It is estimated that it contained more than 5,000,000 tons of stone. Much of the outer casing of the masonry has been torn away, and the present dimensions are approximately 20 ft. less in all directions.

The stones used in its construction were in no case less than 30 ft. in length, and they were quarried in the Arabian Mountains and brought to Gizeh by river. Their transport from the river to the site of the work necessitated the construction of a special roadway of polished stone, 60 ft. in width and three-quarters of a mile in length. The building of the roadway alone took over 10 years, while the complete task involved 20 years of strenuous labour from more than 100,000 slaves!

The second pyramid was the tomb of Chephren, and is only slightly smaller than the Cheops Pyramid. It is 447½ ft. in height and 690 ft. 9 in. square. The third pyramid is much smaller, being only 203 ft. in height and 354½ ft. square at the base, but in beauty of construction it is commonly considered to excel its larger neighbours. It originally contained the remains of the King Mencheres and Queen Nitocris.

The 5m. stamp shows the Sphinx, the largest single piece of sculpture in the world. With the exception of a small temple built between the front paws, and the paws themselves, the whole is carved out of one piece of rock. It has the body of a lion crouching, with the head of a man, and is 146 ft. in length and 34 ft. in breadth. To the top of the head it is 100 ft. in height, the height from the chin being 28 ft. 6 in. The huge size of the Sphinx can best be illustrated by a comparison of its head with the bulk of an average human head, which is 40,000 times smaller! The moving of the gigantic block of stone used in carving the Sphinx is certainly one of the world's most remarkable transport feats.

The 10c. stamp shows the Colossi of Thebes, two great statues, 60 ft. apart and each 47 ft. in height, standing on pedestals about 12 ft. in height, representing King Amenophis seated on his throne. The further of the statues was long known as the Vocal Memnon, owing to the curious whistling sounds emitted from it at sunrise, and many heated arguments have been waged over the cause of these sounds—whether they were a natural phenomenon produced by the wind, or an imposture of the ancient priests. This statue was broken many hundreds of

(*Continued on page 807*

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For further stamp advertisements see page 820

Stamp Collecting—(*Continued from page 805*)

years ago, and since repair has remained silent.

The 20m. stamp shows another of Egypt's most remarkable relics, a great pylon at the Temple of Karnak near Luxor, in the famous Valley of the Tombs of the Kings. This great temple was built in 180 B.C. by Ptolemy IX and covers an area of nearly 420,000 ft., approximately four times greater than the floor area of St. Paul's Cathedral. Its greatest feature was a wonderful hall, 342 ft. in length and 170 ft. in width, the roof of which was supported by 138 massive stone columns, arranged in 14 rows of nine 43 ft. columns, and two rows of six columns, each towering up 62 ft. and having a base diameter of 11 ft. 6 in.

The ancient Egyptians were not only expert in raising remarkable statues, but also in carving them from solid rock in natural cliffs. The outstanding examples of this skill are the wonderful rock temples of Abu Simbel, illustrated on the 100m. stamp. This temple was built to commemorate the great victory scored over the Syrians by Rameses II, the greatest of the Pharaohs, and as our illustration shows its entrance is guarded by four huge statues of Rameses II, each 66 ft. in height, hewn out of solid rock. The 15m. value added to this series of stamps in 1927 illustrates another statue of Rameses II. This is one of several that adorned a temple at Luxor, and is approximately 20 ft. in height from base to head.

There is not space here to describe in detail the designs that have appeared subsequently on the popular Egyptian commemoratives of recent years. There is much of interest among them, however. The Egyptian God Thoth was illustrated on the Geographical Congress Issue of 1925, for example. Thoth was the God who weighed men's hearts and inscribed their deeds upon tablets. The Navigation Congress series (1926) gave a picture of an ancient Egyptian galley reproduced from a carving on the wall of the temple of Dier el Bahari, erected in honour of Queen Hatshepset, who reigned jointly with her father Thothmes I about 1550 B.C. The Statistical Congress issue (1927) showed a statue of Amenhotep, a famous seer, and architect of the many fine buildings erected by King Amenhotep III. The Medical Congress Series of 1928, already mentioned, showed, in addition to the portrait of Mahomet Ali, a picture of Im Hotep, the builder of the step pyramid of Gakkarar, and a doctor of medicine of such great skill that he was deified and a temple erected at Philae to his memory. Finally, the Agricultural stamps of 1931 reproduced an interesting harvest scene of 350 B.C. based upon a carving found in the tomb of Thi, near Cairo.

Readers who care to follow this subject up are assured of many interesting hours of study and the certainty that their supply of material will not fail. Further designs of this nature from Egypt will certainly be forthcoming from time to time.

Stamp Gossip
and Notes on New Issues

Cardinal Mercier Commemorative

Belgium has issued a series of charity stamps in memory of Cardinal Mercier. Full details are not yet available, but it is understood that only the low values, 10c., 50c., 75c. and 1fr., will be placed on public sale, the high values being reserved for subscription orders.

Four designs have been chosen. The first, illustrated here, is employed on the four low values mentioned, and shows a portrait of the Cardinal, set within a framing of croziers. The second is also a portrait of His Eminence, robed as a professor of the University of Louvain, with a bust of Socrates to his left and one of St. Thomas d'Aquin on his right. The third design symbolises the Cardinal's humanitarian work during the Great War and shows him shepherding to safety a group of children and elderly folk. The Cathedral of Malines is shown in the background of this stamp. These designs are to be used on the 1f.75, 2f.50, 3fr. and 5fr. values.

The fourth design will show a full length portrait of the Cardinal arrayed in the full vestments of his office, administering a blessing to a crowd of people. This design appears upon a 10fr. + 40fr. value, produced in a size greater than that of any previous Belgian stamp.

New Greek Designs

The Greek postal authorities have authorised the preparation of three new stamps denominated 50l., 1.50dr. and 4dr. respectively. The design of the 50l. is to show a view of the Corinth Canal; the 1.50dr. the Byzantine church at Mistra, and the 4dr. the Pantheon. The quantities to be issued are 20 millions, 35 millions and 15 millions respectively.

American Air Mails

The growth of the air mail facilities of the American continents is interestingly shown in recently issued statistics. The total route mileage open was 6,436, of which 1,350 miles were illuminated and regularly used for night flying. More than 19 million letters, representing a weight of 210 tons, were carried under Post Office air mail contracts.

An interesting sidelight is that is it now possible to post letters at Aklavik on the Canadian Arctic coast for conveyance all the way by air to points as far south as Buenos Aires and Valparaiso.

* * * *

A recent Paris announcement foreshadows a new issue of postage stamps in honour of the memory of the late President of the Republic. The issue will be made on 6th May next, the first anniversary of the assassination of M. Doumer.

The Dornier Do.X Air Mail

No small commotion has been created in aerophilatelic circles by the local efforts to "profiteer" on the resale of the special air stamp issued for use on the mail carried to Europe from Newfoundland by the Dornier Do.X on 23rd May last. Eight thousand copies of the existing $1 air stamp were overprinted with a five-line inscription reading: "Transatlantic West to East per Dornier Do.X, May, 1932. One dollar and 50 cents." Only a small quantity of the stamps was actually used for mail, however, and the bulk of the supply was "cornered" by speculators, some of whom were demanding as much as $10 per stamp within less than 24 hours!

The stamp will command a substantial premium in course of time, but the leading stamp dealers have definitely refused to talk business until a more reasonable attitude is adopted.

Lew Reichers, the American pilot, who was forced down when only a short distance from the Irish Coast on his lone trans-Atlantic flight from Newfoundland, also carried a quantity of mail, but as it was found impossible to salvage the machine, it seems probable that this mail has been lost for ever.

* * * *

Among stamp issues shortly to appear, a correspondent in *Gibbons' Stamp Monthly* reports a new 2d. pictorial from the Turks and Caicos Islands to advertise the islands' salt making industry. The printing will be 60,000 copies.

* * * *

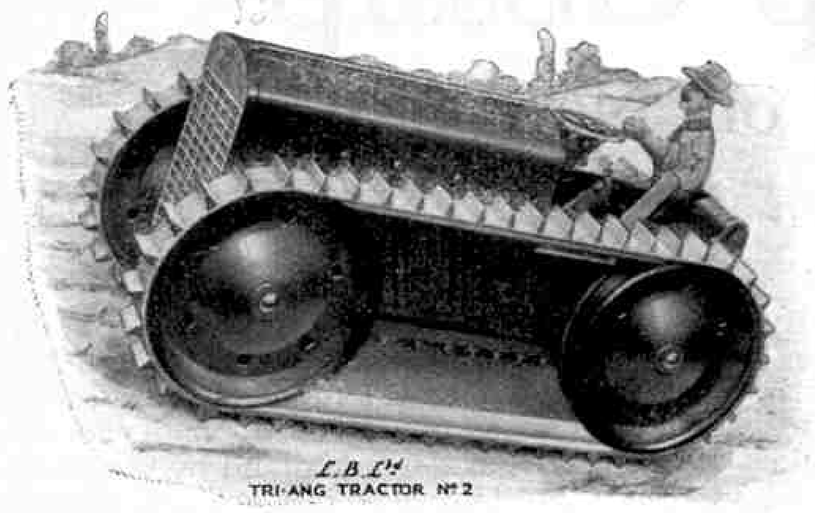
The occasion of the unveiling of a national memorial in Brussels on 21st July was selected for the issue of yet another Belgian Commemorative, in this instance to celebrate the deeds of the Belgian Army infantry forces in the European War.

Commemorating a Tree Planter

A collection of stamps illustrating National Customs would be a highly interesting subject study for some enterprising reader to undertake. To illustrate the type of stamp to be included we show here the commemorative stamp issued by the United States in April last, to mark the centenary of the birth of J. Sterling Morton, who originated Arbor Day, a day set aside for the planting of new trees. The idea was officially adopted by the State of Nebraska in 1872 and has since been observed each year.

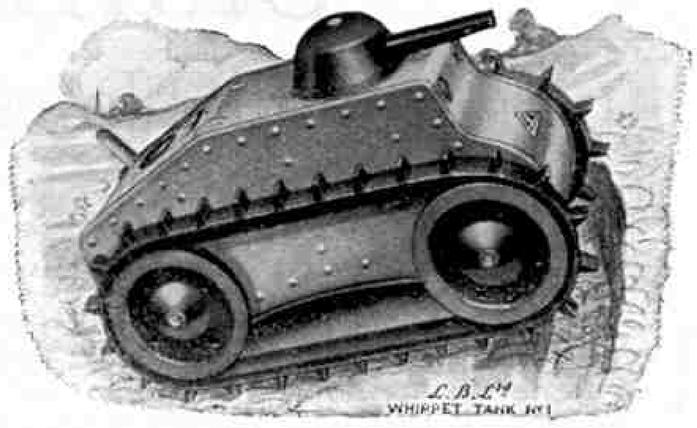
We thank Stanley Gibbons Ltd. for their courtesy in loaning the stamps from which the illustrations for our stamp pages have been made.

New Tri-ang Powerful Clockwork Toys



TRI-ANG TRACTOR No. 2. - - 3/11d.

Steel construction, cellulose painted red. Reliable motor with control lever. Rubber bands on steel wheels. - - - - - - - - - *Length 8½ ins.*



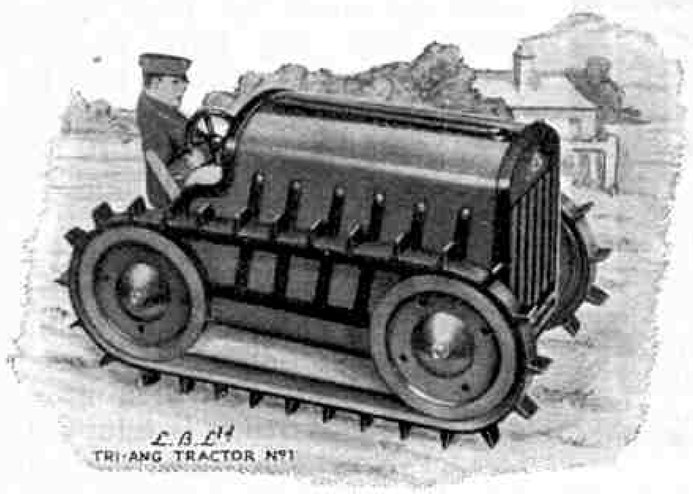
"WHIPPET" CLIMBING TANK No. 1. - - - - - - 1/-

A miniature of a climbing fighting tank. Strong motor, control lever. Swivelling gun turret. Rubber bands. - - - Length 5¼ ins

L. BROS. LTD. LONDON BR OS. ENGLAND

Regd. Trade Mark.

A fine new range of clockwork toys to work with your models. Real precision jobs, British made—Tractors, Tanks and Motor Cars There are other models besides those shown here, including Magic Sports, Saloon and Racing Cars. Get full particulars now.



TRI-ANG TRACTOR No. 1 (Nippy) - 1/-

Climbs obstacles in a surprising way. Thick rubber bands. Control lever. - - - - - - - Length 5¼ ins.

TIGER CLIMBING & FIGHTING TANK No. 2 - - - - - - 5/11

A powerful climber, made of steel, with wide rubber bands. Swivelling gun turret with firing device. Control lever. - - - - Length 10 ins.

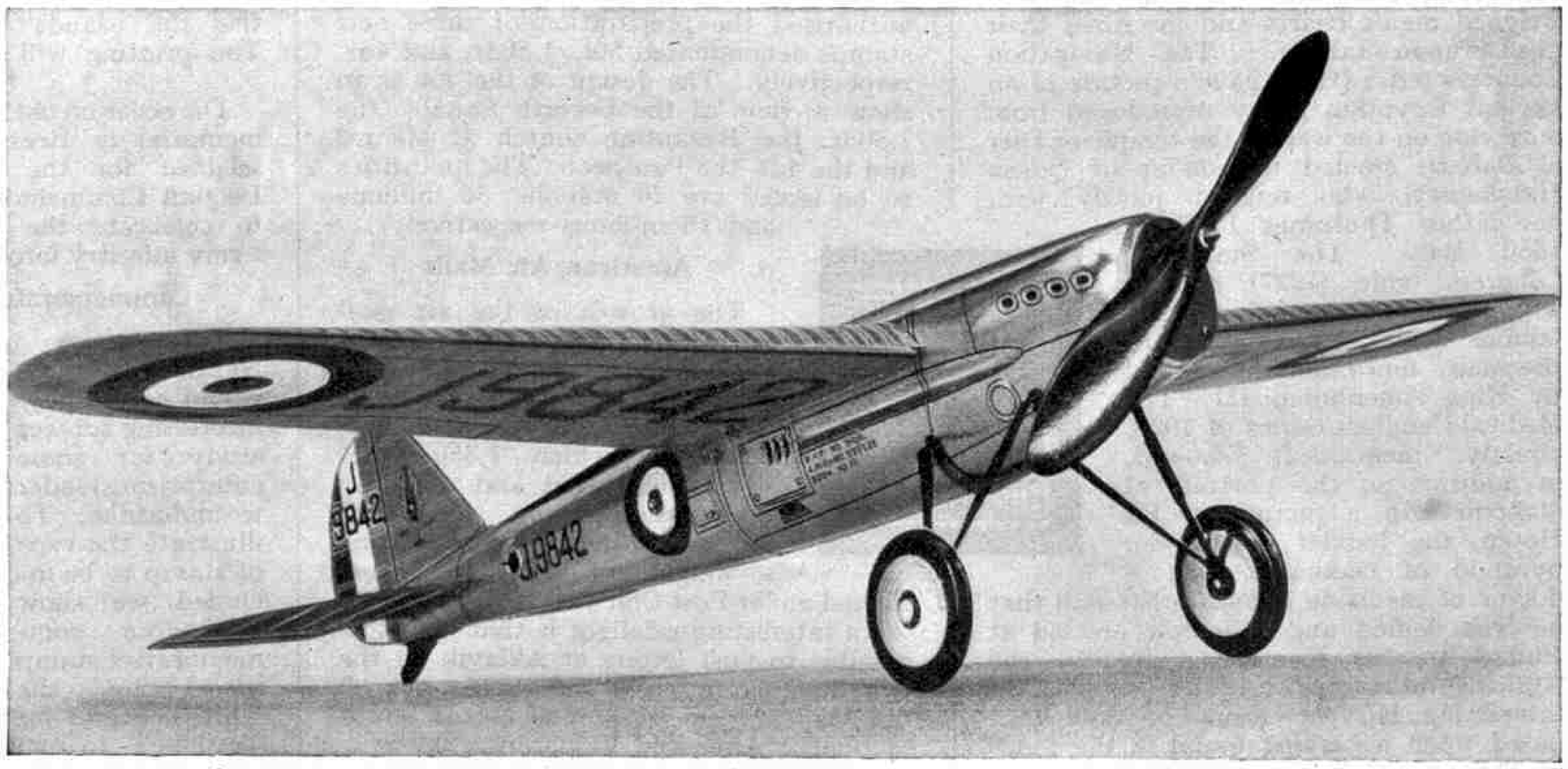
TRI-ANG TOYS

Regd. Trade Mark.

British Made by LINES BROS. LTD., TRI-ANG WORKS, MORDEN RD., MERTON, LONDON, S.W.19

The F·R·O·G Flying Model Interceptor Fighter

A perfect scale model of the real thing. Rises from ground in 3ft.—flys 300 ft. Fully wound in box in less than 1 minute. Performs all the evolutions of a real machine, including looping the loop. Patent construction avoids damage



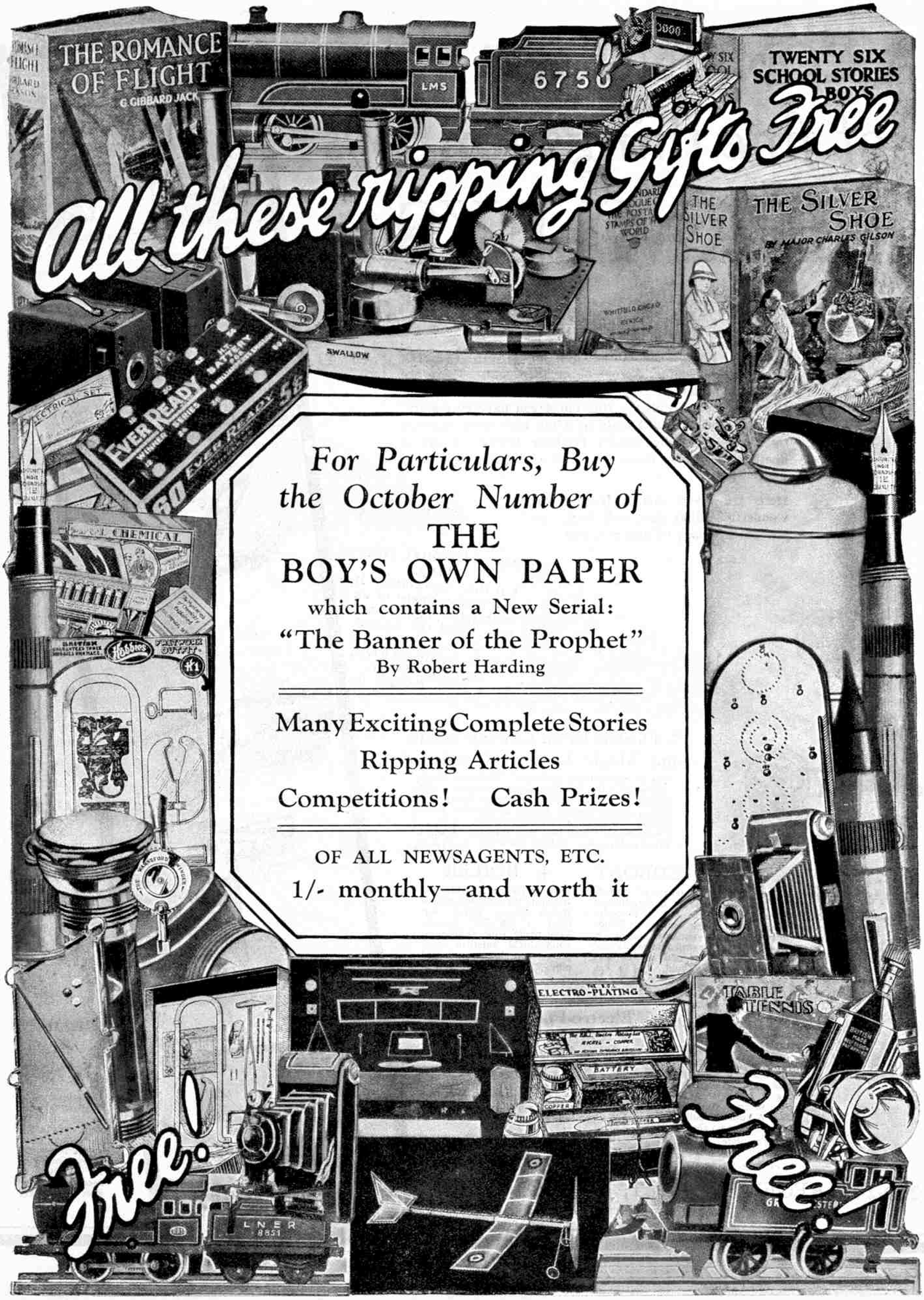
FROG TRADE MARK REGD.

Length 9¼ ins. Wing Span 11½ ins. Weight ¾ oz.

British Made by INTERNATIONAL MODEL AIRCRAFT LTD.

PRICE 10/6

Write for particulars to the sole concessionaires:—
LINES BROS. LTD., MORDEN ROAD, MERTON, LONDON, S.W.19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A CONTINUOUS SHOW *of fine things for boys* at HAMLEYS

200-202, REGENT STREET, LONDON

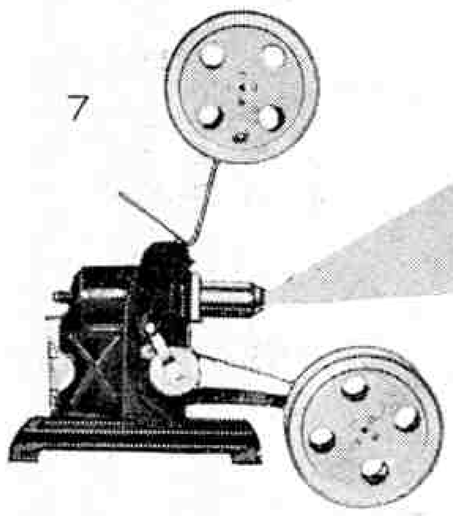
There is always something new at HAMLEYS. The latest model Engine, Aeroplane or Speedboat. There are Airguns, Tanks and Toy Soldiers of every description. Working Model Railways (the finest you have ever seen), and Speedboats and Yachts in a big boat tank, spanned by a model of the Sydney Harbour Bridge. There is another big bridge to see, too, with Trains passing over it.

Here are given just a few of the wonderful things that will bring joy to the heart of any real boy.

3

A SCALE MODEL THAT FLIES.
F.R.O.G. Aeroplane. It is a perfect model of an interceptor fighter and Flies Right Off Ground. Flying speed 650 ft. per minute, distance 300 feet, ceiling of 70 feet.
Price 10/6. Postage 6d.

7



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2. SPEEDBOAT

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4. BOILER

This boiler is suitable for steaming the outboard engine shown below, which will drive a 26"-28" launch. Well made with aluminium wind shield, supplied complete with lamp and feed pipe. Price **6/6** Postage 6d.

5. OUTBOARD ENGINE

A perfect model steam outboard engine. A powerful high-speed engine capable of propelling a 26" boat at a scale speed of approximately 40 knots. A suitable boiler for this model is shown above. Price complete, fitted with lugs, **9/6** Postage 6d.

6. Electro-Plating Outfit

A real electro-plating outfit by which you can plate in nickel or copper. Any metal article, such as taps, door and window fittings can be plated without removal or small articles with equal ease. No experience necessary. Price **8/6** Postage 9d. Suitable battery, 1/3.

200-202, REGENT STREET, LONDON, W.1

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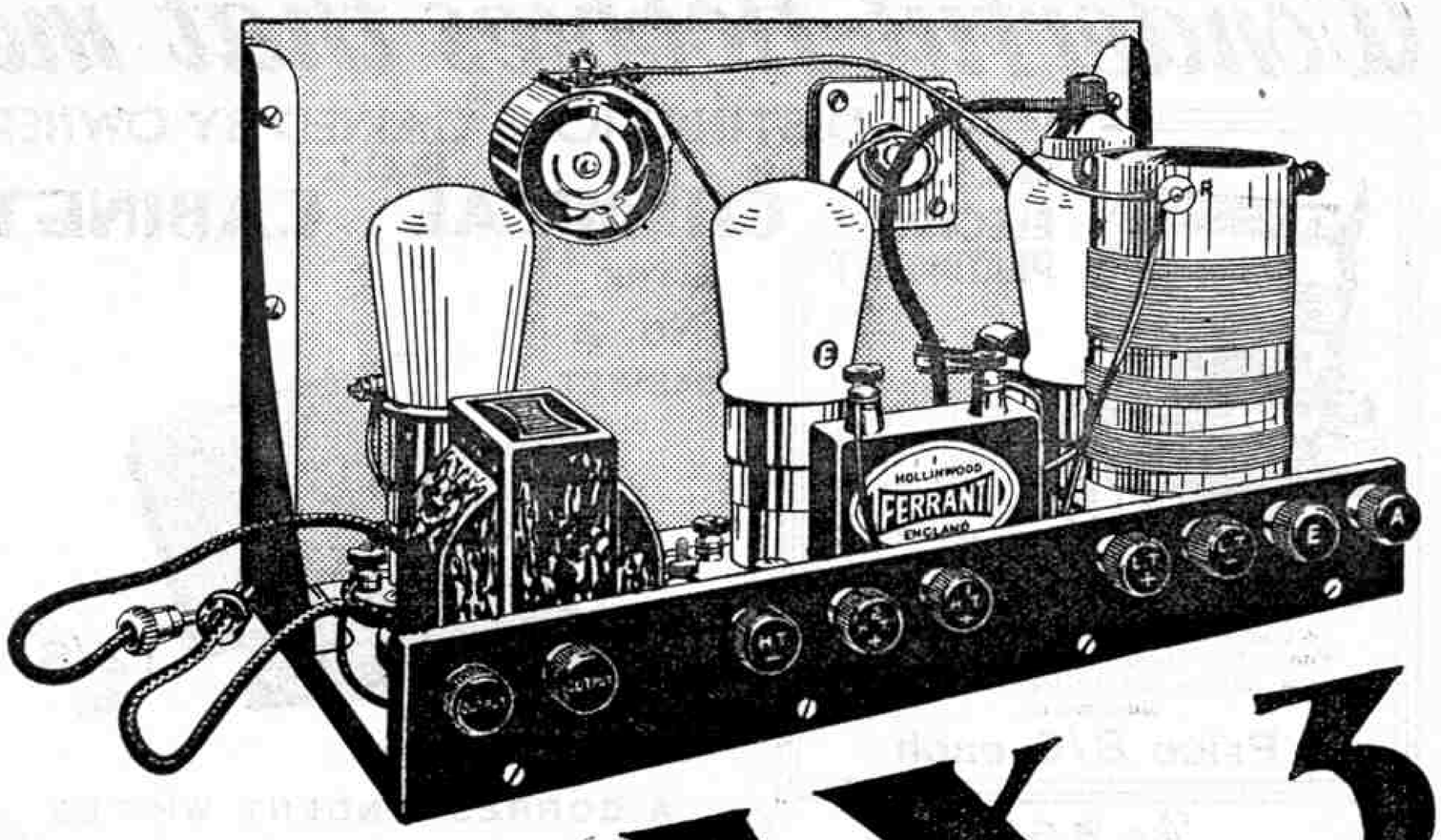
THE LAST WORD IN KIT SETS



THE MINIMAX 3

Designed by Ferranti, and only 40/-

Minimum Cost — Maximum Quality. An ingenious PATENTED KIT that you can assemble in an hour or so! A battery SG3 Receiver within the reach of every purse.

Not claimed as the "best ever" — super quality cannot be got at so low a price — but the "Minimax" is the product of a House famous for giving the last ounce of value for money.

The motto of the "Minimax" designers has been to obtain the maximum performance at the minimum cost. No low-priced kit set has ever been simpler to construct, and no kit set at anything like the price can give such profound satisfaction.

Don't delay. Ask your dealer for free Constructional Chart, or write direct, enclosing 1½d. postage.

MAKE THE

FERRANTI MINIMAX 3

Without Valves, Batteries, Cabinet, Panel and Baseboard

FERRANTI LTD., M. Circuit Section, HOLLINWOOD, LANCASHIRE

Wonderful Hobbies that mean Progress

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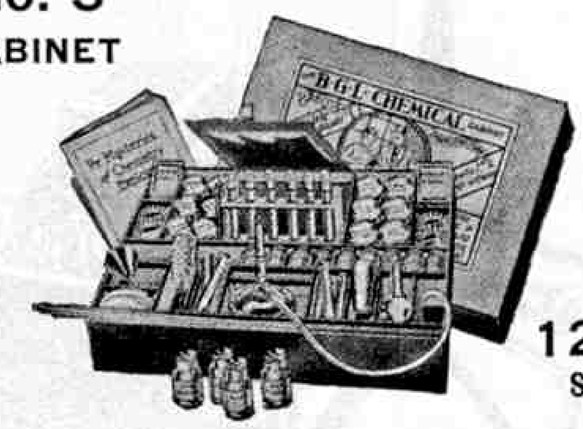

12/6 Size

The B.G.L.
ELECTRO-PLATING SET

This unique outfit gives a genuine electrical deposit in nickel or copper on any metal article fixed or otherwise. No experience required.

Equal to Commercial Plating

Complete with copper and nickel electrodes, copper and nickel plating salts, mixing jars, battery leads and full instructions.

Price 8/6 each

The B.G.L.
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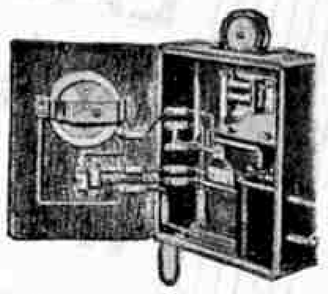
Not a toy but a really efficient instrument. This is the most wonderful and useful constructional outfit ever produced.



Instal your own Telephone

No experience required. Thousands already in use everywhere.

No. 1. All parts for building two complete instruments **21/-**
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Full instructions supplied.

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WIREWORKING SET

Complete with fully illustrated instruction book showing how to solder and to make dozens of useful articles in wire and tinplate, such as lampshade, frames, plate hangers, flower baskets, etc., etc.

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If any difficulty in obtaining, write the manufacturers.

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HERE IS DEFINITE PROOF OF THE VALUE OF CHEMICAL SETS BUT THEY MUST BE B.G.L.

The above illustration shows a typical B.G.L. Cabinet. Note the value and attractiveness.

Prices :
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The B.G.L.
ELECTRICAL SETS

A wonderful series of experimental outfits that will delight the heart of every modern boy or girl. Arranged on similar lines to the Chemical sets, they afford hours of interesting and instructive amusement. Complete with fully illustrated instruction book.

Prices :
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Get this new TERRY CAPE HOLDER

(Regd. No. 774290)

It clips to the seat pillar stem, fits snugly beneath the saddle and carries oilskins, light waterproofs, spare tyre, papers or small parcels.

NO STRAPS REQUIRED
—it automatically grips and is instantaneously opened and closed.

Weighs only 2 ozs.
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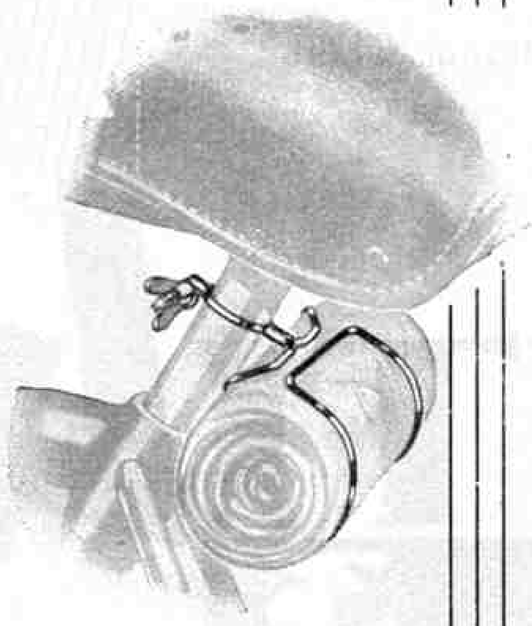
No. 1186 - **1/-** each



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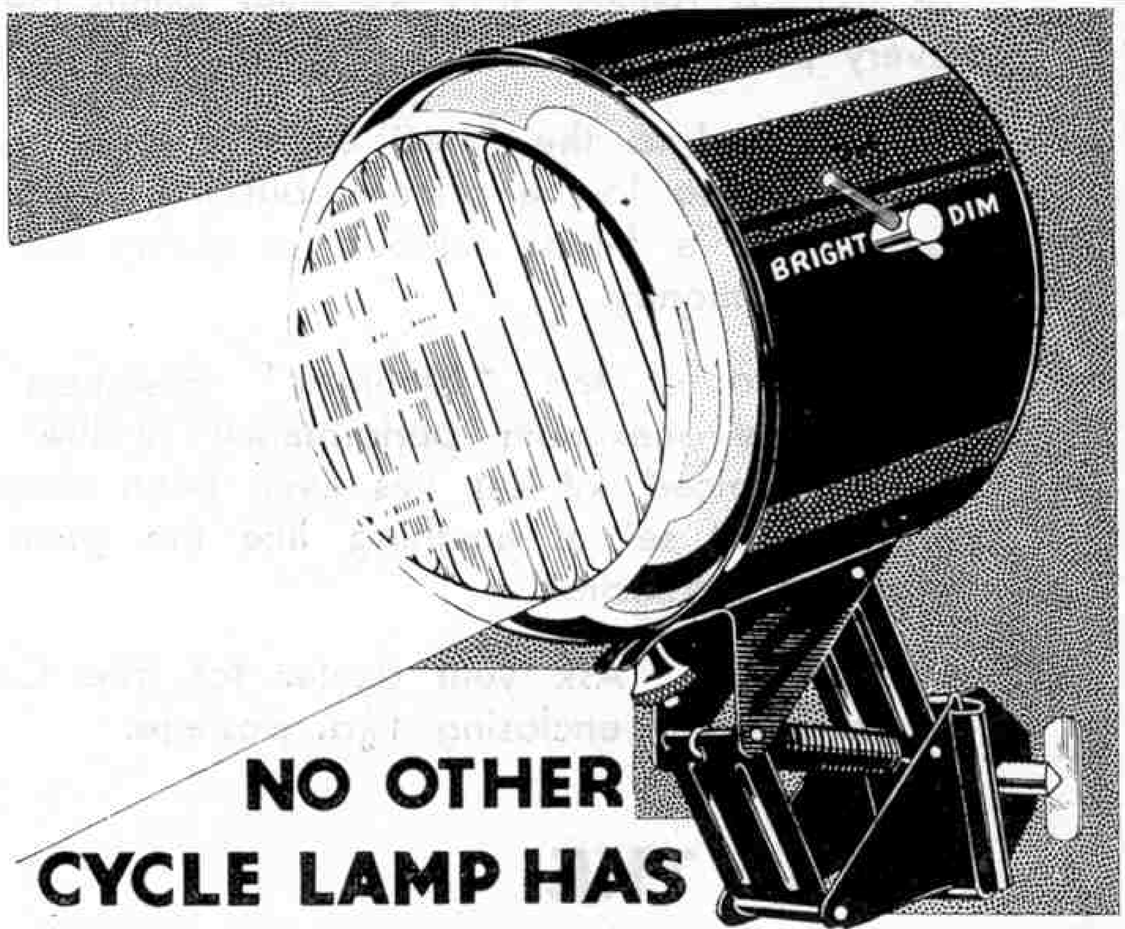

NO OTHER CYCLE LAMP HAS THESE FEATURES

- TWIN SWITCH
- 90 FEET BEAM
- 30 HOURS LIGHT
- From 2 Pocket Batteries

This is what the Pifco Headlamp gives you: two beams—90 feet of lavish focussed light for the country lanes or, at a turn of the switch, a dim and sedate beam for the town; over 30 hours of unfaltering light at a cost of ½d. an hour from two Pocket Batteries; a spare bulb carrier ingeniously fitted inside the lamp. This is the headlamp for you! Cheaper in use than carbide and cleaner than oil. And with a beam, mark you, that can put many a motorist's "in the shade"!

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Booklet on riding safer, post free from :
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5/- Complete **PIFCO** ELECTRIC CYCLE LAMP

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has arranged these experiments for YOU

In the "lab." you don't often get the chance of tinkering about on your own. That's why we know you will be keen on Lott's Chemistry. A Doctor of Science has selected and arranged many interesting chemical experiments for you—all of which will provide you with a lot of fun and scientific knowledge.

These are some experiments :— Growing Chemical Trees ; Big Crystals ; making coloured flares, etc., etc.

Lott's Chemistry is supplied in 5 sizes—larger boxes will shortly be ready.

BOX 1 with 18 Chemicals, accessories and book of 42 experiments. **Price 3/6**

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The above prices apply in Great Britain only.

Spares supplied. Obtainable from leading toy dealers and stores.

BOX 2. PRICE 6/-

Lott's Chemistry is perfectly safe to handle.

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FOR THE WINTER EVENINGS

PROFITABLE PLEASURE !

A REAL PRINTING PRESS IN MINIATURE.

USES THE SAME TYPE OF ROLLER, THE SAME INK, THE SAME TYPE AND PRINTS EQUALLY AS WELL AS THE LARGER MODELS.

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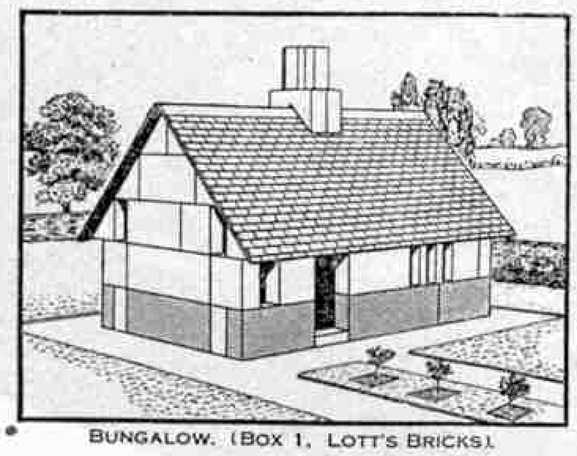
For your Model Railway

It's great un loading up your trains with bricks and sending them off by rail to the sites chosen for the buildings.. What realistic models, too, you can build with Lott's Bricks :—Houses, Bridges, Towers, Railway Stations, Garages—in fact, all the buildings you see about you every day. The Tudor Series contains many designs of Old English half-timbered buildings. Lodomo sets are complete with bricks embossed with designs of Doors, Windows and Bonded brickwork. All the sets contain illustrations of the models printed in colours.



BUNGALOW. (BOX 1, LOTT'S BRICKS).

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A few particulars of some of the sets :—

BOX 1. Contains bricks, roofs, trees and fences, and plans for 30 models. **Price 5/-**

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TUDOR BLOCKS at 3/6, 7/6, 21/- per box.

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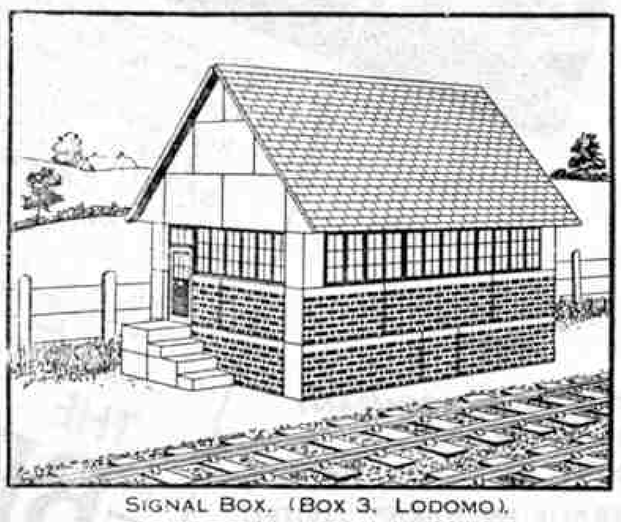

SIGNAL BOX. (BOX 3, LODOMO).

Write or complete list illustrated in colours.

Dept. M.M.,
LOTT'S BRICKS LTD.,
WATFORD, HERTS.

HOME IS THE MOST ATTRACTIVE PLACE

—when there's a
RILEY "HOME" BILLIARD TABLE

Keep your boys at home. Buy a Riley "Home" Billiard Table, cash or easy terms, and provide a never-failing attraction which will keep the family together during long winter evenings. For 13/3 down the 6 ft. size (cash price £11 15s. 0d.) is delivered to your door. The balance you pay as you play.

4 ft. 4 ins. x 2 ft. 4 ins.	£ 7	0	0
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6 ft. 4 ins. x 3 ft. 4 ins.	£11	15	0
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or in 20 monthly payments of 8/-, 10/3, 13/3, 17/-, 24/6.

13/3 DOWN

brings the 6ft. size Riley "Home" Billiard Table to you on 7 days' free trial. Rileys pay carriage and take all transit risks.

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A magnificent piece of furniture, ready for either purpose in a few minutes. Available in many attractive styles in oak or mahogany. Cash prices from £22 10s. 0d. upwards. Easy Terms available for every table.

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In the 10/6 outfit, illustrated above, there are 34 different chemicals, and a splendid assortment of glass tubing, filters, test tubes, rubber tubing, corks, asbestos papers and millboard, Bunsen Tubing, trays, scoops, test tube holder, test tube brush, Bunsen Burner and a splendid book full of experiments and instructions.

What a wonderful difference that magic word KAY makes. It is the hallmark of quality and usefulness. The boy who gets a KAY outfit gets the best possible value at the price ; an outfit packed full of interest and amusement.

ASK FOR A KAY OUTFIT!

British Made

6 SPLENDID OUTFITS GIVEN AWAY

every month until the end of 1932.

Three Kay Electrical Outfits value 21/–, 15/– and 10/6 each, and Three Kay Chemistry Outfits value 21/–, 15/– and 10/6 each, will be given away to the boy or girl who sends the best answer, in not more than 25 words, to the question :—

"WHY ARE KAY CHEMISTRY AND ELECTRICAL OUTFITS THE BEST ?"

Entries for each month must be received before the 28th of the month. Send your answer with the name and address of your local dealer to :—

THE KAY SPORTS CO.,
Competition Dept.,
Pembroke Works, LONDON, N.10.

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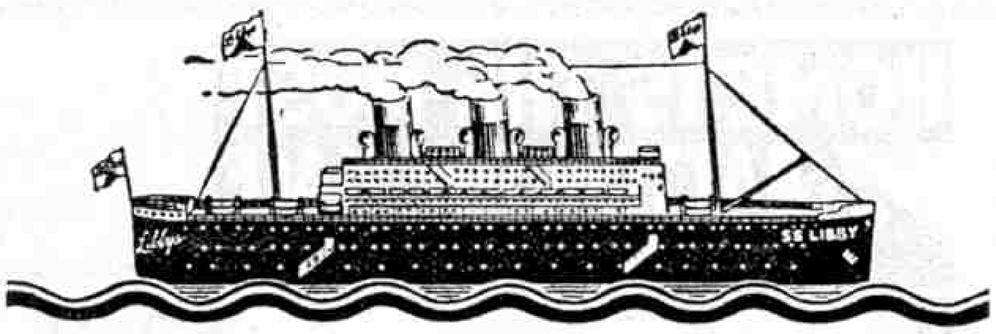
In the 10/6 outfit, illustrated above, there are 3 bulb holders, 3 shades, 3 bulbs, a splendid double-coil Electric Bell, a bell push, battery tester, turnscrew, 1-way switch, a wonderful Electric Induction Coil, battery clips, insulated staples, a supply of bell wire and twin flex, a tin of Kay insulating tape and a splendid book full of experiments and instructions.

Obtainable from all leading Stores, Toyshops and Sports Shops. If you have any difficulty, please send direct to the manufacturers :—

THE KAY SPORTS CO. PEMBROKE WORKS LONDON, N.10



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get this model steamship Free

Would you like a model steamship free? If so, collect 12 blue and white labels from Libby's famous foods and send them with your name and address to Libby's, 8 Great Tower Street, London, E.C.3.

In exchange you will receive the numbered parts with full directions for building the ship for yourself. It is a fascinating model and great fun to build.

LIBBY, McNEILL & LIBBY LTD.
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LG 5-96

BUILD YOUR RAILWAY LAYOUT WITH **BRIKLO** REGD.

Standardized parts, Locking Bricks and Scaffolding, Real Windows, Real Doors, Tiled Roofs—Chimneys.

Real blue-print plans for constructing HOUSES, SHOPS, CHURCHES, RAILWAY-STATIONS, FACTORIES, SIGNAL CABINS, ENGINE SHEDS, etc.

No. 1 Set ... 20/–
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This is an entirely new invention and supplies are not yet in all shops. If your dealer has not yet stocked BRIKLO send Postal Order or Cheque to

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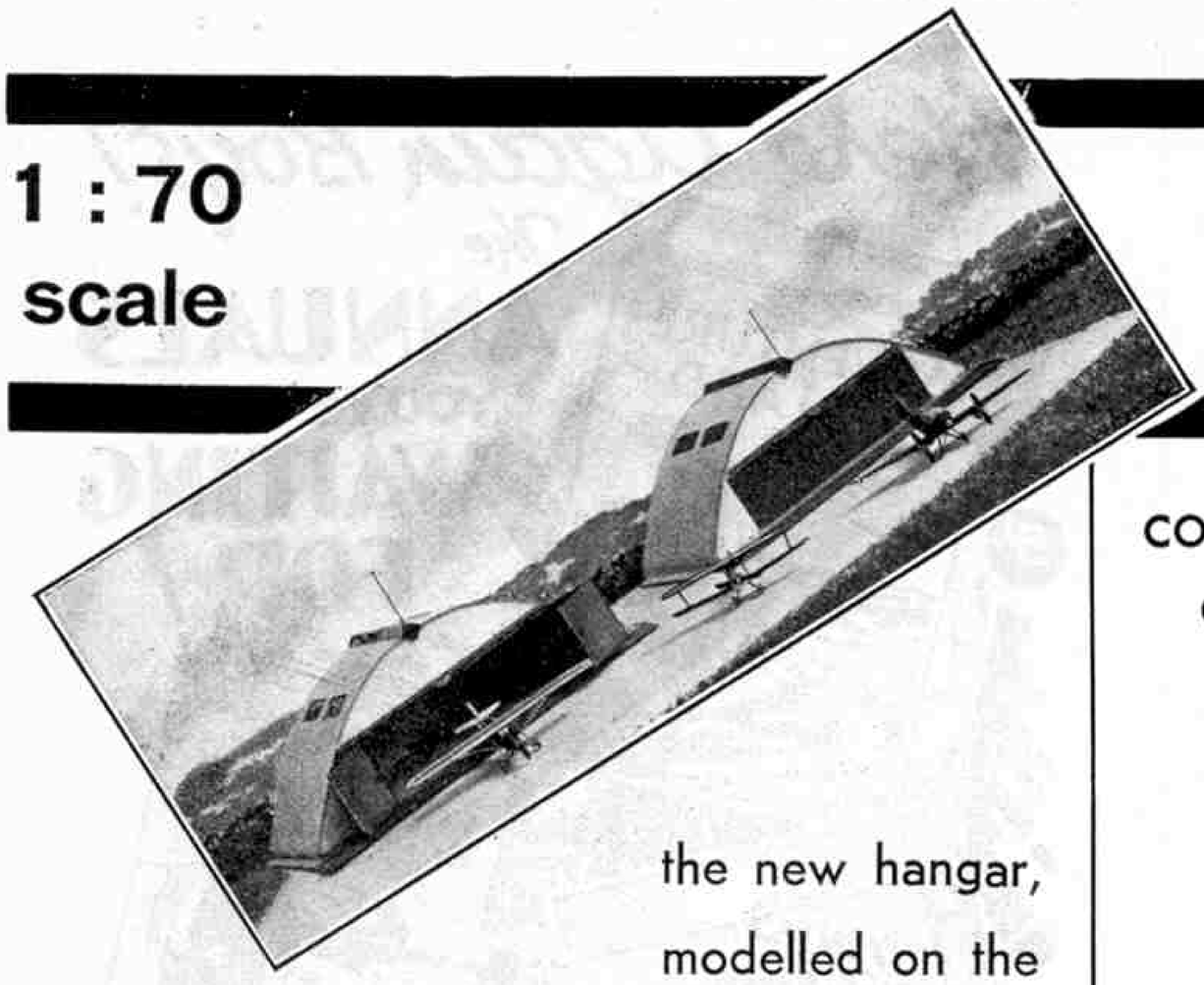
TRADE ENQUIRIES INVITED.

THE BRIKLO COMPANY

1 : 70 scale



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hawker "fury"
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in preparation—
lockheed "vega" and fokker d.vii.

make a complete aerodrome and have an air pageant of your own

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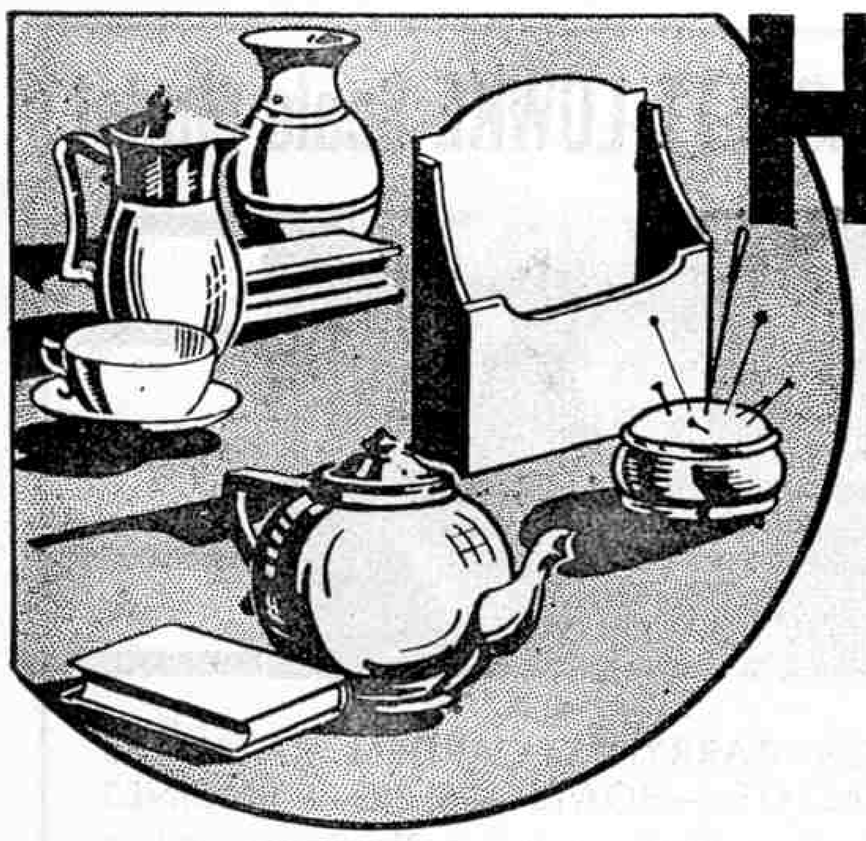

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There are dozens of odd jobs you can do at home with Seccotine. Making things, mending things, for yourself and your mother and father. But **make sure you use SECCOTINE.** Seccotine is more than TWICE AS STRONG as any other adhesive and there is only one **SECCOTINE.** Famous for nearly 50 years, it has no substitute. Used by the Admiralty and by the Air Force. STICKS EVERYTHING. **MADE BY BRITISH WORKPEOPLE.**

Obtainable in tubes, **4½d., 6d.** and **9d.** at all good Stationers, Ironmongers and General Stores.

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I should like to have, post free, a copy of your Free Booklet.

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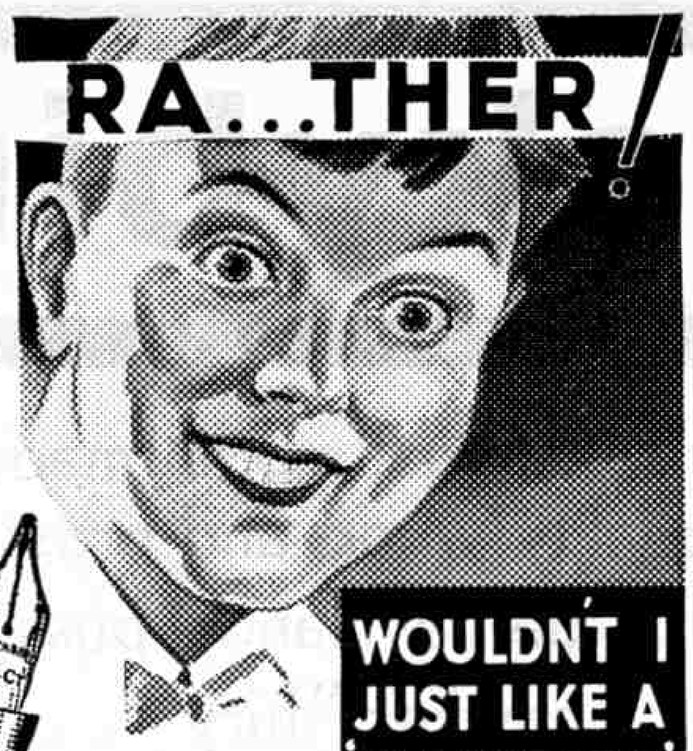

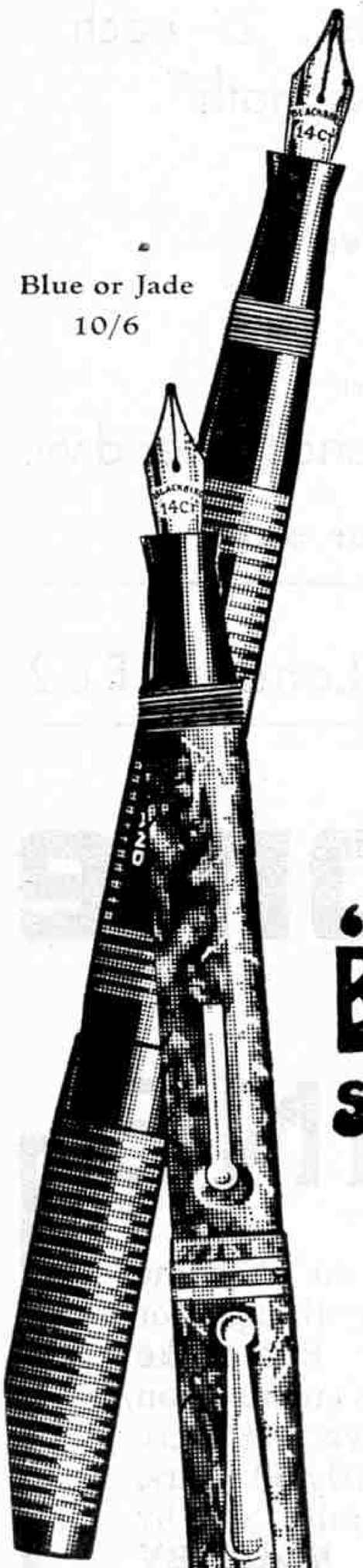

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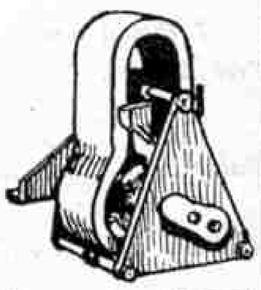

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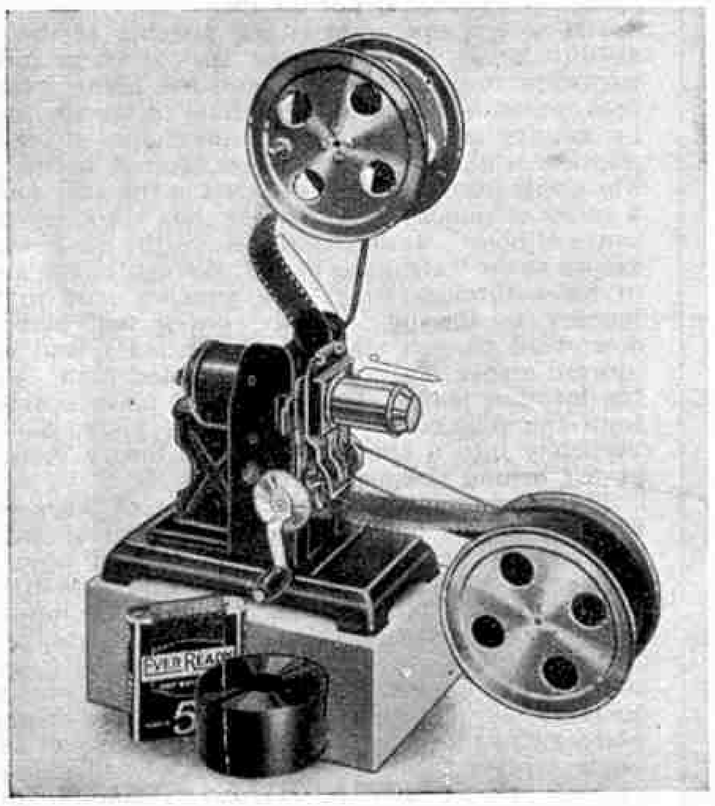

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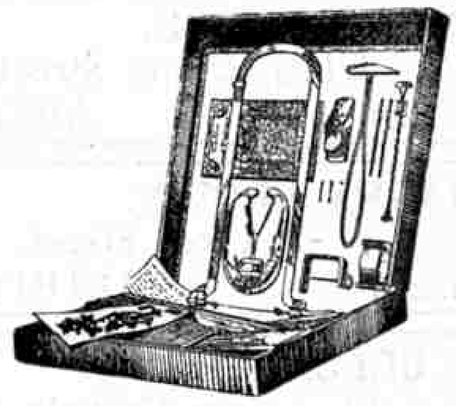

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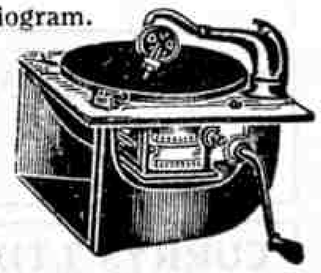

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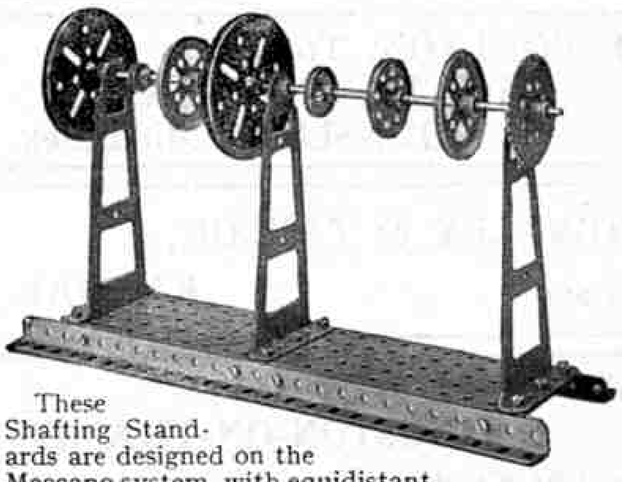

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Life Story of Meccano—(*Cont. from page 773*)

of the press. The steel is fed into the machine automatically, the coil travelling at a speed sufficient to feed the exact amount of metal necessary to make one blank during the time in which the ram moves up and down. At each downward stroke the top tool cuts through the coil, blanking out a piece of metal the exact shape of the die.

The second operation is the piercing of the equidistant holes. In this case the press is inclined backward from the vertical and the blank from the first operation is fed into the chute of the tool, to fall by gravity against a location plate that holds it in position while the piercing operation is carried out. The upper portion of the tool used in this case contains a series of punches, and the die has a corresponding series of holes. Immediately above the die is what is known as the "stripping plate," also containing a series of holes through which the punches pass in their journey to the die. As the upper tool makes its downward blow it stamps out the holes, and on its upward stroke it draws the perforated plate clear of the location plate. The perforated plate is stripped from the punches by the stripping plate, and falls vertically into a chute and thence into a receptacle placed behind the machine.

The third operation is the bending of the sides, or flanging of the plates. The type of press and the feeding are precisely as in the second operation. The upper tool coincides in shape and size with the inside form of a finished Flanged Plate, the lower tool corresponds to the outside form of the plate.

The big press shown in the illustration on page 773 is one of the largest in the department and works at a pressure of 70 tons. Among typical operations performed by this machine are the bending of 24½-in. angle girders from flat girder strip; blanking the circular pieces of steel for Hornby turntables, and the combined forming, piercing and blanking of Meccano 3 in. pulley wheel sides in one operation.

A particularly interesting section of the department is the Hornby rail-making plant, which comprises guillotine, quadruple-action presses and rail curving machines. First of all standard sheets of tinplate 20 in. by 28 in. are cut into small sheets of a width equal to the length of the rail to be made. These sheets are passed through a rotary gang slitting guillotine and cut into small strips 19 at a time, which are fed into the rail-making presses at the rate of from 40 to 50 per minute. With a single blow the presses convert the strips of tin into lengths of rail, Vignole's section, after which they are carried away on a continuously-moving belt to the curving machines.

The curving is done on wheels of different diameters according to the radius required. The edge of the wheel is grooved to take one half of the Vignole's section of the rail. At the top of the wheel, and running in contact with it, is a series of small rollers lying alongside one another, each grooved to take the other half of the Vignole's section. The space in the grooving allows the rail to pass through as it travels with the wheel, and it is quickly bent to the curve required. The curved rails as they leave this machine are stacked in bundles in readiness for assembly to the sleepers.

Another interesting press, the Wright high-speed die-ing machine, is used particularly for blanking operations. The making of a 5½" Strip is a typical job. With a double tool the machine can turn out 200,000 such Strips in a day of 8½ hours—a striking contrast to the output of 12,000 strips from a hand-fed normal speed power press. In operation, a coil of steel is fed into the machine by means of an automatic roll feed, so that the blanks are cut from the coil at even spacing without any waste of material. Before entering the tool the steel is oiled by passing over an oiled felt roller running in an oil bath. At each stroke the machine pierces two strips and blanks out two others.

The Wright machine is used in the production of a wide range of parts, among these being all sizes of strips from 5½ in. downward, spanners, washers and trunnions. Using a multiple tool, as many as 1,000,000 washers can be turned out in a day!

(*To be continued*)

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Other features are a focussing adjustment and a 3-way safety switch with "Off," "On" and "Intermittent" positions. Focussing is adjusted by a turning movement of the head. The depression of a stud enables the whole head of the torch case to be removed, thus making the interchangeability of the bulb an easy and simple matter. Each torch is fitted with a spare bulb, protected from breakage by a domed cover fitted inside the bottom cap.

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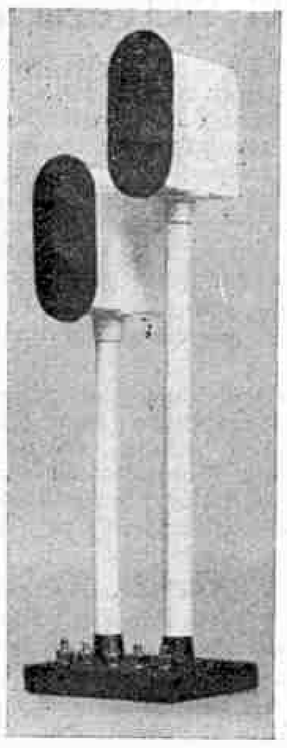

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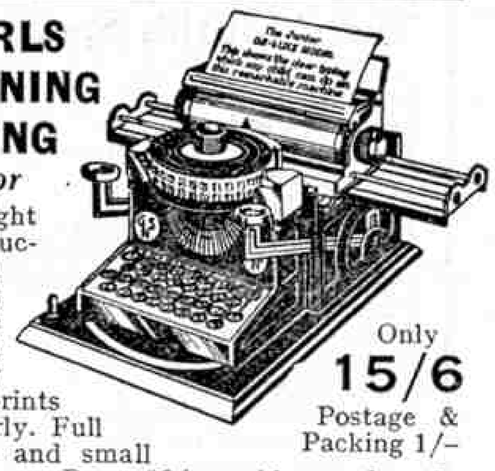

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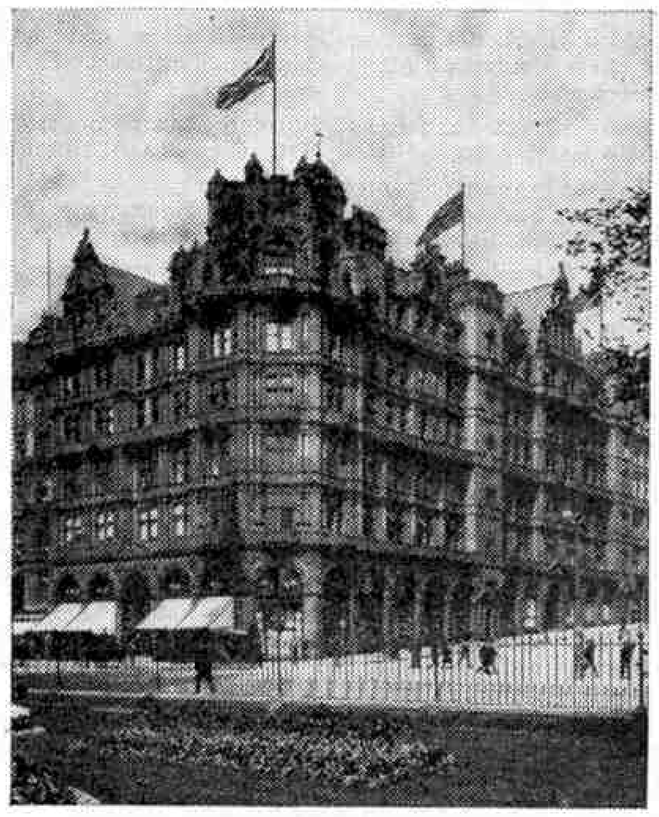

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Sale. 46 "M.M.s," August, 1928–May, 1932. Fine condition. Best offer secures.—D.B.S., 2, Chase Hill, Enfield.

"Meccano Magazines," June, 1930 to August, 1932. Clean, 3d. each. Also "Boys' Own Papers," and Detective Stories. Write to—Earle, 27, Melford Road, S.E.22.

"Duke of York" Loco, unused. Cost 28/6, August. 16/6. Four Golf Clubs. Cost £2/10/–, 5/– each. "M.M.s," Books. Exchange for coupons.–G. Macdonald, Brownhills, St. Andrews.

Sale. "Meccano Magazines," 1927-1931 complete. Good condition. Offers?—Kitto, 108, Broadway, Southend-on-Sea.

Sale. Good second-hand Banjo; Model Yacht. 24 inch, Cutter Rig. Write—Sams, 33, Valley Road, Shortlands, Kent.

Sale. Locos, Rolling Stock, etc. Good condition.—Reeves, 22, Lacy Road, Putney.

Result of August Competition Kay Sports Company

The names of the prize-winners in the Kay Sports Company's Competition announced in our August issue, are as follows:—First Prizes: Miss Joan Wise, 28, Gerard Road, Harrow, Middx.; Master Raymond Martin, "Lorain," Winstonian Road, Cheltenham. Second Prizes: Master Robert Eke, "Slindon House," 11, Quarry Bank Road, Brighton; Master Cecil Woods, Woodhaven, Wormit, Fifeshire. Third Prizes: Master J. Inglis, 34, St. Mary's, Bootham, York; Master E. Blomiley, 5, The Avenue, Shaw, Nr. Oldham.

Further competitions will be announced each month until the end of the year. Full details will be found in the Kay Sports Company's advertisement on page 814 of this issue.

This Month's Special Articles

	Page
Air News	750
Books to Read	768
Building Your Own Motor Cars	776
Competition Page	803
Engineering News	756
Exploring the Stratosphere	754
Famous Admirals—II. Sir Francis Drake	742
Famous Air Lines—I. Imperial Airways	752
Fireside Fun	801
From Our Readers	766
Gramophone News	771
Guild Pages	788–9
Hornby Railway Company Pages	791–799
How Fireworks are Made	758
Life Story of Meccano	772
Locomotives of a Century Ago	765
Meccano Aerial Bombing	774
Meccano Graphing Screen	787
Meccano Model of "Nelson Column"	785
Model-building Contest	784
Model-building Contests Results	783
Railway News	760
Romance of Whaling	739
Prize-Winning Models in £500 Contest	780
Sea Dogs of the North	744
Sleuth Hounds of the Navy	734
Stamp Collecting	805
Stamp Gossip	807
Story of the Flexible Locomotive	762
The Heaviside Layer	749
Welland Ship Canal	736
With the Model-Builders	779
"What Shall I Be?"	746

RAILWAY PHOTOGRAPHS

Send 4d. for specimen card and NEW list (M12) of titles. Also Aeroplane photographs—NEW list (A2) and specimen 4d. (84 additional titles in all.) (All photographs postcard size.) 3d. each, 2/6 per dozen (post free).

Railway Photographs, 23, Hanover St., Liverpool.

Stamp Advertisements cont. from p. 806

Stamps! Packet 500 on approval. Pick any at ½d. each.—Wyk, 576, Chester Rd., Manchester.

£1 PACKET FREE with ½d. and 1d. Approvals.—Cheeseman, Addiscomb Road, Watford.

100 DIFFERENT STAMPS FREE. Send for ½d. Approvals.—Cox, 21, Dennis Mansions, Westcliff.

NO GIFT. Just value for money in cheap Appros. Discount.—Stampco, 27, Rectory Rd., London, S.W.6.

VALUABLE GIFTS, to all asking for my Approvals.—H. Bennett, 15, New Street, Chatham, Kent.

FREE. 1932 set of 3 Sarawak to Approval applicants.—Kennedy, 27, Newlands Avenue, Southampton.

1,000 STAMPS including Colonials, Siam, Persia, Montenegro, 10d.—Cranwell, 54, Churchill Road, London, N.W.2.

Rare Triangle Air Mail Free to Approval applicants. Postage 2d. Best Quality Bank Mixture, 1/– packet.—Eyers (M.M.), 3, Post Office Parade, Parkstone, Dorset.

FREE. Full Set (9) Scarce Roumania Boy King or fine set of 8 Carol (including rare 16 lei) to Approval applicants enclosing postage.—Sanders, 90, Newlands Avenue, Southampton.

FREE MINT PICTORIALS to serious applicants for J Class Approvals. You must write for these Bargain Booklets. Hundreds sent and none priced over one penny. Liberal discounts.—Avenue Stamp Co., 33, Cornwall Avenue, London, N.22.

This Space is set to ½ inch s.c. and costs 8/– per month. The sum is the 50th of £20, the price of a whole page advertisement. Over 90,000 copies of the December number were distributed all over the world. You therefore reach this exclusive public for approximately one penny a thousand.

Reduction in Prices of Modelled Miniatures

The prices of Modelled Miniatures Nos. 1, 2, 3, 4, 5, 13 and 21 have been reduced as follows:—

No. 1	**Station Staff**	**From 2/– to 1/6**
No. 2	**Farmyard Animals**	**„ 2/– „ 1/6**
No. 3	**Passengers**	**„ 2/– „ 1/6**
No. 4	**Engineering Staff**	**„ 2/– „ 1/6**
No. 5	**Train and Hotel Staff**	**„ 2/– „ 1/3**
No. 13	**"Halls" Distemper Advertisement**	**„ 1/– „ 9d.**
No. 21	**Train Set**	**„ 2/9 „ 2/6**

The revised prices came into force on the 1st September, 1932.

MECCANO LIMITED, LIVERPOOL.

MECCANO MAGAZINE

Registered at G.P.O., London, for transmission by Canadian Magazine Post.

EDITORIAL AND ADVERTISING OFFICE:—

OLD SWAN, LIVERPOOL, ENGLAND.

Telegrams: "Meccano, Liverpool."

Publication Date. The "*M.M.*" is published on the 1st of each month and may be ordered from any Meccano dealer, or from any bookstall or newsagent, price 6d. per copy. It will be mailed direct from this office, 4/– for six issues and 8/– for twelve issues.

To Contributors. The Editor will consider articles and photographs of general interest and payment will be made for those published. Whilst every care will be taken of articles, etc., submitted, the Editor cannot accept responsibility for any loss or damage. A stamped addressed envelope of the requisite size should be sent where the contribution is to be returned if unacceptable.

Readers' Sales and Wants. Private advertisements (i.e., not trade) are charged 1d. per word, minimum 1/–. Cash with order. Editorial and Advertising matters should not be dealt with on the same sheet of paper.

Advertisers are asked to note that private advertisements of goods manufactured by Meccano Limited cannot be accepted.

Small Advertisements. 1/6 per line (average seven words to the line), or 16/– per inch (average 12 lines to the inch). Cash with order.

Display. Quotations for space bookings, and latest net sale figures, will be sent on request.

Press Day, etc. Copy should be sent as early in the month as possible for insertion in following issue. We usually close for press on or before 6th of each month for following issue. Half-tone blocks up to 100 screen.

Proofs of advertisements will be sent when possible for space bookings of not less than half-an-inch.

Voucher copies. Sent free to advertisers booking one inch or over. Other advertisers desiring vouchers should add 8d. to their remittance and should order voucher copy at same time.

Remittances. Postal Orders and Cheques should be made payable to Meccano Ltd.

Ordering the "M.M." Overseas

Readers Overseas and in foreign countries may order the "*Meccano Magazine*" from regular Meccano dealers or direct from this office. The price and subscription rates are as above, except in the cases of Australia, where the price is 1/5 per copy (postage extra), and the subscription rates 9/6 for six months and 19/– for 12 months (post free); Canada, where the price is 15c. per copy, and the subscription rates 75c. for six months, and $1.50 for 12 months (post paid).

The U.S.A. price is 15c.per copy, and the subscription rates $1 and $2 for 6 and 12 months respectively (post free).

Overseas readers are reminded that the prices shown throughout the "*M.M.*" are those relating to the United Kingdom and Northern Ireland. Current Overseas Price Lists of Meccano Products will be mailed free on request to any of the undermentioned agencies. Prices of other goods advertised may be obtained direct from the firms concerned.

CANADA: Meccano Ltd., 34, St. Patrick St., Toronto.

UNITED STATES: Meccano Co. of America Inc., New Haven, Conn. Meccano Co. of America Inc., 200, Fifth Av., New York.

AUSTRALIA: Messrs. E. G. Page & Co., 52, Clarence Street, Sydney, N.S.W.

NEW ZEALAND: Models Ltd., P.O. Box 129, Paykel's Building, Anzac Avenue, Auckland.

SOUTH AFRICA: Mr. A. E. Harris (P.O. Box 1199), 142, Market Street, Johannesburg.

INDIA: Karachi: Bombay Sports Depot, Elphinstone Street, Bombay; Bombay Sports Depot, Dhobi Talao. Calcutta: Bombay Sports Depot, 13/C, Old Court House Street.

The Editor wishes to make known the fact that it is not necessary for any reader to pay more than the published price. Anyone who is being overcharged should lodge a complaint with the Meccano agent in his country or write direct to the Editor.

A Model Steamship Free Offer

Libby's, whose food products are so popular, are offering to readers of the "*M.M.*" a cardboard waterline model steamship in exchange for labels from their famous blue and white label food products.

The steamship is supplied in sections, each of which is numbered to correspond with clearly worded instructions, thus simplifying the assembly of the model.

Full details of Messrs. Libby's offer will be found in their advertisement on page 814.

MECCANO
MOTOR CAR CONSTRUCTOR

THE MOST
ATTRACTIVE TOY
EVER PRODUCED

SPECIAL FEATURES OF MECCANO MOTOR CAR CONSTRUCTOR MODELS

High power Drive

Ackermann Steering Gear

Internal-expanding rear wheel brakes

Solid die-cast wheels fitted with rubber tyres

Chromium-plated lamps, radiator and bumper

Every boy who loves to build models will want this splendid Motor Car Constructor Outfit. It is the latest Meccano development and without doubt one of the most attractive toys ever produced.

With it you can build models of sports and speed cars, each strikingly realistic and a masterpiece of design and workmanship. An extremely powerful clockwork motor is included giving the models a run of 150 feet on one winding. The parts contained in the Outfit are sturdily made and beautifully finished in rich colours as follows :—

Body : Choice of Red, Blue or Green.

Mudguards : Cream.

Wheel Discs : Vermilion or Blue.

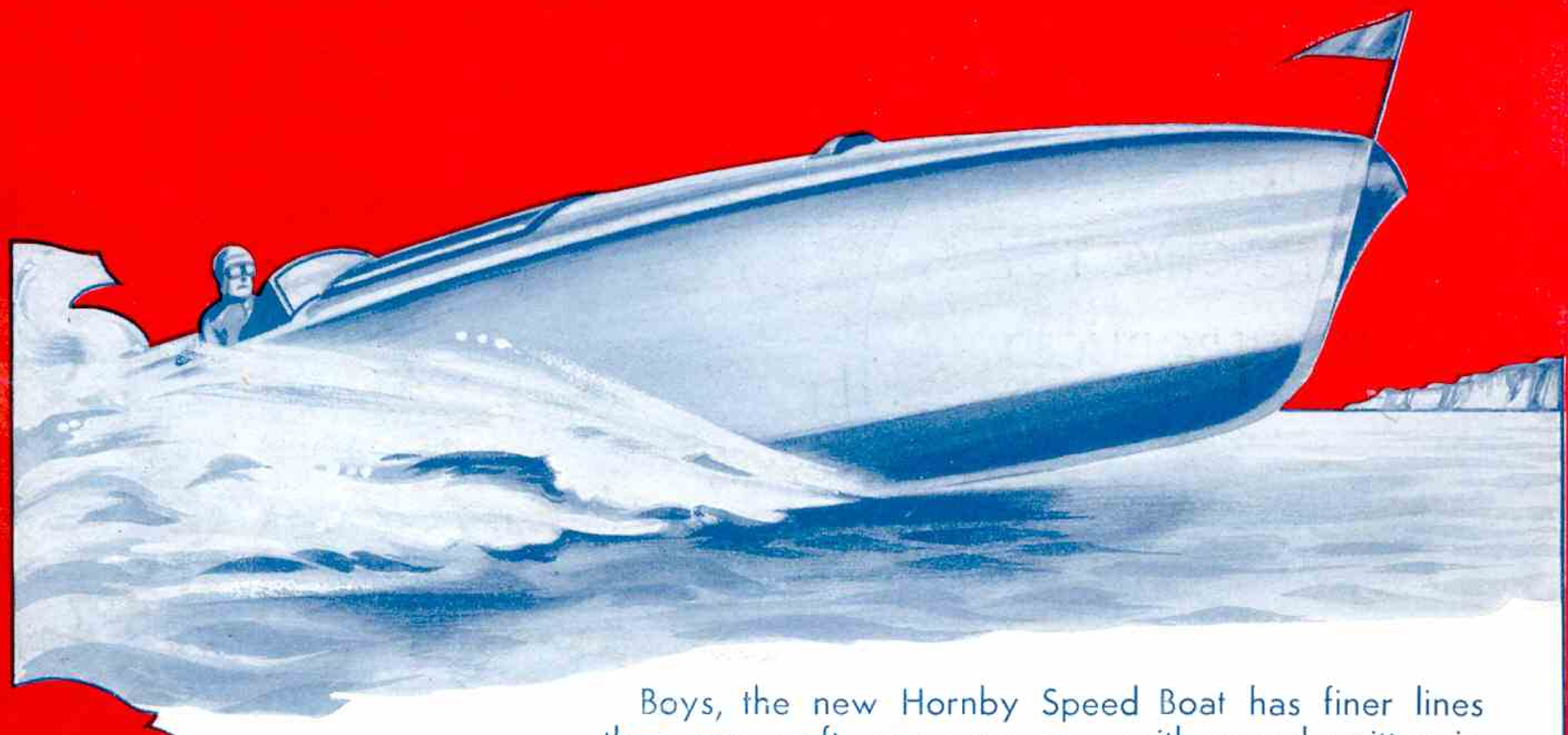
Radiator Frame, Bumper and Lamps : Chromium-plated.

Price 25/-

MECCANO LTD., Old Swan, LIVERPOOL

THE NEW Hornby Speed Boat

500 feet on one winding!



Boys, the new Hornby Speed Boat has finer lines than any craft you ever saw, with speed written in every inch of her streamlined hull. On one winding of the powerful motor she races away for a distance of 500 feet, smoothly riding the waves, just as real speed boats do.

The Hornby Speed Boat measures 16½ inches from bow to stern and 3½ inches in beam. She is available in three different colour combinations—Green and Ivory, Red and Cream, and Blue and White. Her clockwork motor is designed and made on the same lines as the motors of the world-famous Hornby Trains.

If you want to spend happy hours buy a Hornby Speed Boat to-day and have races with your friends.

Ask your dealer to show you this fine Speed Boat

PRICE **12/6**

HORNBY SPEED BOAT

MANUFACTURED BY MECCANO LIMITED OLD SWAN LIVERPOOL

PUBLISHED BY MECCANO LTD., OLD SWAN, LIVERPOOL, ENGLAND.
Printed by John Waddington Ltd., Leeds and London.